# SCIENTIFIC AMERICAN

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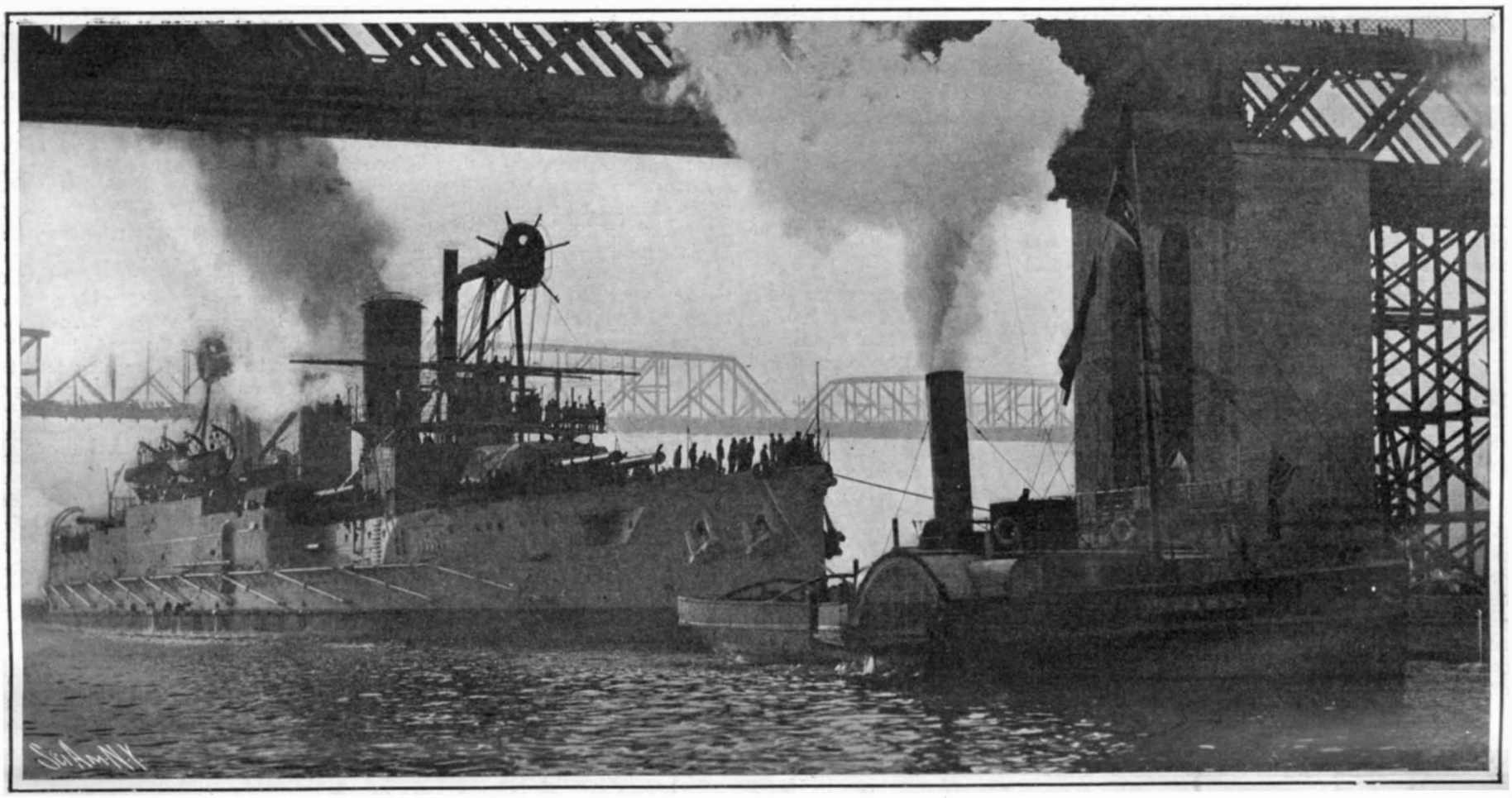
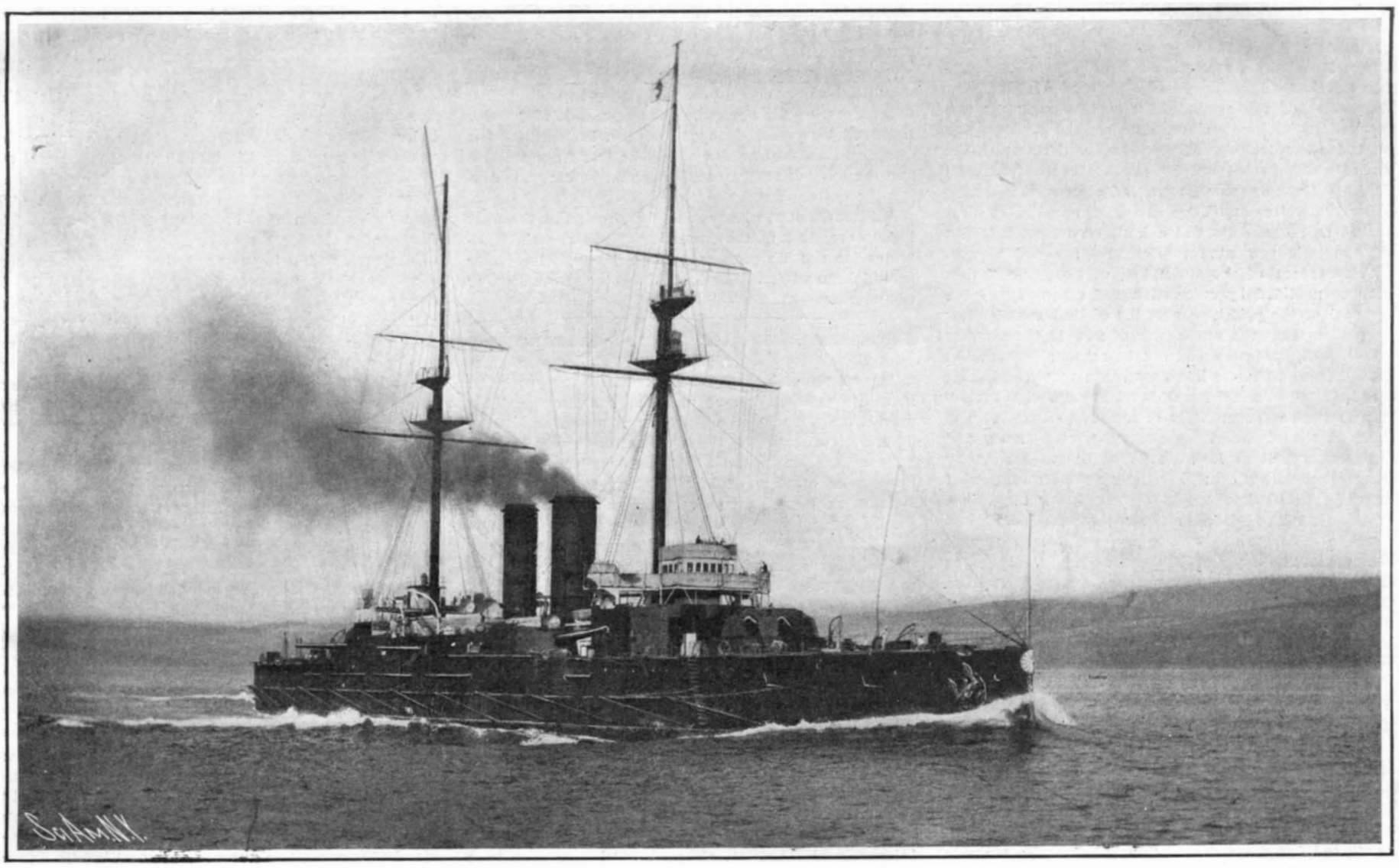


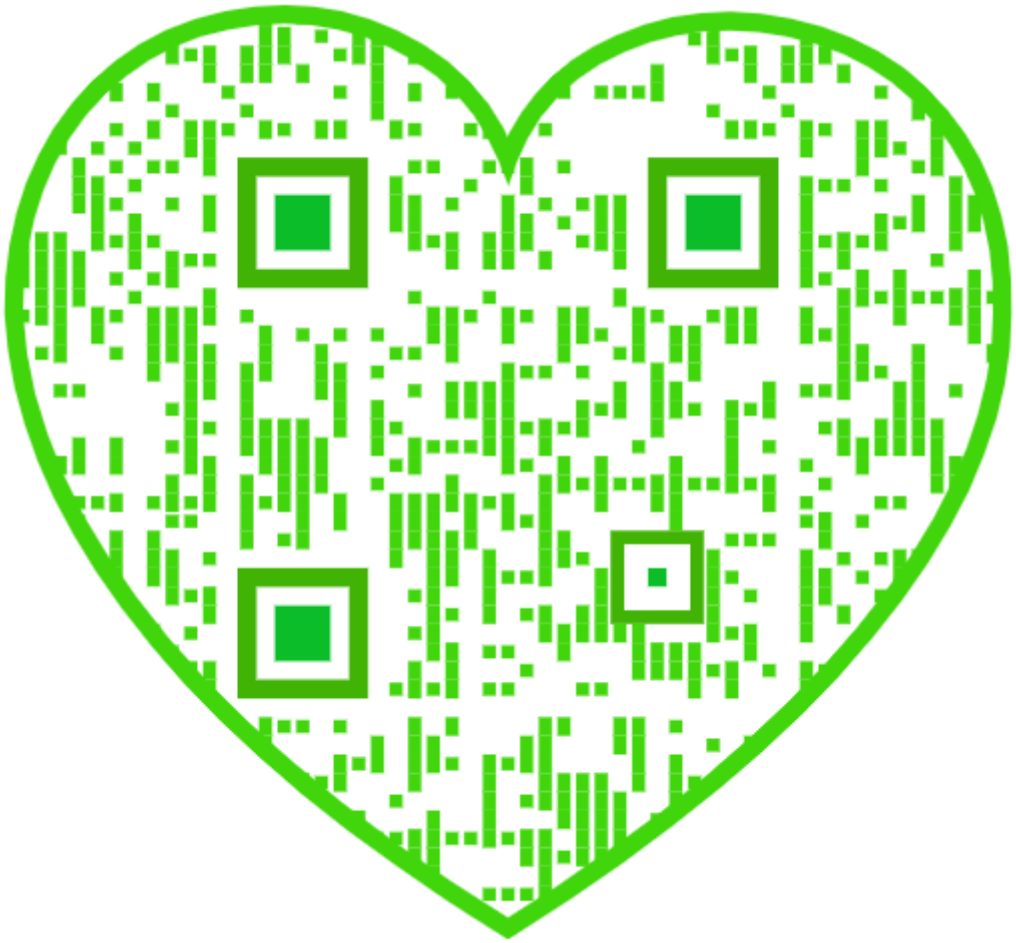
The Japanese Battleship "Kishima," Sister Ship of the "Katori," Steaming Out to Sea for Her Trial Trip.



**The New Japanese Battleship "Katori" on Her Trial Trip. Contract Speed, 18.5 Knots.**

The "Katori" and the "Kishima" are the two most powerful battleships thus far built. They are armed with four 12-inch, four 10-inch, and twelve 6-inch guns, besides twelve 12-pounders, three 3-pounders, and 6 pompons. Their armor consists primarily of a 7½-foot belt varying in thickness from 9 inches to 6½ inches and extending 5 feet below the water line.


**THE NEW JAPANESE BATTLESHIPS "KATORI" AND "KISHIMA."—[See page 47.]**



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NEW YORK, SATURDAY, JULY 21, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles wi l be paid for at regular space rates.


## RECLAMATION OF MARSH LANDS IN THE SOUTH.

The agricultural conditions of the coast and tidal river lands of South Carolina have been the subject of more or less discussion since 1878, at which time a report was submitted by a committee of the South Carolina Agricultural Society, suggesting certain radical changes in their management. Although many of the labor complexities then complained of have disappeared, the problem of the profitable utilization of these lands still confronts the proprietors. Mr. Elwood Mead, of the United States Department of Agriculture, has pointed out that the lands which may be used for agriculture are of two different classes—those of the coastal plain lying above high tide, a large portion of which are swampy and unfit for continued cultivation except in the most favored localities, and the bottom lands bordering the tidal rivers, which are unfit for use without the protection of banks or levees. Rice grows upon the river lands, and rice has long been a staple crop of the South Atlantic coast. It is a question, however, whether the plain lands may not be able to contribute more to the prosperity of their owners and the State than the more celebrated rice lands.

A strong sentiment has therefore developed in the eastern part of the United States for the drainage of tidal and swampy lands, especially in the South where large areas of swampy land abound, so infested with malaria-breeding mosquitoes that agricultural settlement and the successful establishment of manufacturing enterprises have been all but impossible. The irrigation and drainage investigators of the Department of Agriculture are co-operating with a drainage and sanitary commission appointed by the legislature of South Carolina for the purpose of improving the health of the communities about Charleston and increasing the land values. During the coming year plans for the drainage of new areas will be made, the work to be carried out by the State Drainage and Sanitary Commission with the aid of convict labor.

South Carolina and Virginia would, perhaps, be most benefited if the plans which have been formulated in various bills presented to Congress are carried out.

The surface of the watershed of the streams has been so modified by cultivation and especially by the removal of the primitive growths of timber and other vegetation, that the uniformity of flow in the streams found thirty years ago cannot be reasonably expected in the future. There has been, as a result, a falling off of the total annual rainfall, yet no apparent diminution in the maximum daily or monthly rainfalls. The flood height of the streams is greater at times, and less constant than formerly. The lesson taught by these observations are: First, that the diminution of annual rainfall does not necessarily lower the height of the river flood line, or the consequent height and strength of levees required to protect the land, though the maximum may not be reached as frequently as during periods of greater average rainfall; second, that the periods of light annual rainfall have a direct effect upon the quantity available at times when it is necessary to flood the rice. If this volume is too small the only water to be had is brackish or salt.

The South finds itself confronted by this dilemma: The growing of rice is too hazardous to be continued where there is danger from salt water. On the other hand, no other valuable field crop will grow on wet land.

In view of the investigation which was made by the Department of Agriculture, the area used for a century or more for the growing of rice must be abandoned and cultivated for other crops. The chief reason for this conclusion is to be found in the fact that the fresh-water supply required for flooding has become insufficient and uncertain. The use of brackish water and inadequate drainage has caused rice blight. No plantation along either the western or eastern branch of the Cooper River has any assurance of a fresh-water supply from that stream. In 1904 no less than 2,552 acres planted the previous year were abandoned because of salt water. In 1905 only 1,115 acres were planted on this branch, and 1,222 acres on the east branch, making a total of 2,337 acres, and of this acreage 300 were watered from reservoirs. Prior to 1904, 2,065 acres had been abandoned, so that since 1890 two-thirds of the acreage formerly planted on these two branches has been abandoned.

Three things should be done to solve the problem: The existing levees must be strengthened, rebuilt, and made high enough to withstand floods; the inclosed lands must be ditched so that soil water can be removed to a depth of three feet; pumping plants must be installed to remove all such drainage water as cannot be removed by gravity through sluices or trunks.

Ditches can be dug which will drain the soil to a depth of fully three feet, making it firm and suitable for the growing of dry land crops and the use of such machinery as will be required in their cultivation.

The improvement of the coastal plain lands, which are estimated to include an area of 400,000 acres, only 50,000 of which are under cultivation, is a matter of vital importance. These lands require a gravity drainage and proper cultivation to make them productive. The coast lands may be drained as were the mosquito-ridden prairie marshes of Illinois and Indiana, now among the most productive and fertile areas in the land.

The first benefit to accrue from the drainage of the low lands in the Carolinas will be to make them sanitary, free from malaria, and attractive to those who contemplate the purchase of farm homes in the Carolina climate, which is most salubrious. With a general drainage system, which may be easily constructed if equitable State drainage laws are enacted, the further drainage of all the lands by means of the more elaborate system of under-drainage, which has proved so efficient in the improvement of low lands elsewhere, can be prosecuted by land owners as desired. These lands, when drained, will require but a fraction of the artificial fertilizing used on the higher lands, and will be in such a condition that a rotation of crops suited to the climate may be followed and the fertility of the land be maintained. If looked into carefully it will be found that the value of commercial fertilizers used during two seasons upon the high lands will in many cases meet the expense of such a drainage system as will be required to make the low lands both healthful and productive.

The entire drainage problem may be put as follows:

The coastal section of the State must be drained before it will be sufficiently healthful to attract thrifty and intelligent farmers. This can be done in such a way as to make the country sanitary, with the exception of the river lands, for $5 per acre, and for high-class cultivation for $10 or $15 per acre. The tidal river rice lands, which are injured by salt water, should be converted into drained fields, and planted in upland crops. This may be done at a cost of $15 per acre. If this were done on the two branches of the Cooper River, that section would be free from malaria and the finely-located residences could be occupied during the entire year.

A State drainage law should be enacted at the next legislature, and in the meantime the plans and estimates for the drainage of a few representative tracts should be made and discussed for the information of the public.

## AUTOMOBILE RACING AND TOURING IN FRANCE AND AMERICA.

Two of the main automobile events of the year—the French Grand Prix race and the American Glidden tour—have attracted the attention of all automobilists. Of these two contests, the former, which was held in France on June 26 and 27, is the substitute arranged by the Automobile Club of France for the Gordon Bennett race—unfortunately a rather sorry substitute for an event that had become a classic in automobile annals by reason of its six years' dramatic success.

The rules under which the trophy was contested for, provided for an annual international race to be held in the country which won the trophy during the year previous. Each country was allowed a team of three machines, and these were usually selected, in France and America at least, by eliminating races of domestic machines. Not content with having won four out of six races, the French last year demanded a greater proportion of their machines in the race—a demand unjustified by their previous success and decidedly unfair to other nations. Consequently, they returned the trophy to the donor and organized the Grand Prix race, in which any manufacturer was allowed to enter a team of three machines. As a result the event lost its international character, although foreign nations were not excluded. France and Italy, however, were the only countries represented. The rules under which this race was run were somewhat different from those used heretofore. The race lasted two days, and was run on the Sarthe circuit—a triangular course some 62¼ miles in length. Six rounds were made each day by the contestants. No repairs or renewals of tires were allowed other than those which could be made by the driver and his mechanic without outside aid. According to the rules, the racer was placed in a garage, at the end of the first day's run, and could not be touched until the start on the following morning.

The chief result of these regulations was the appearance of a new detachable rim. Fully-inflated tires were carried on extra rims. If a puncture occurred, it was only a matter of two or three minutes to remove the deflated tire and rim and apply a fresh one. Like nearly all high-speed automobile races, the Grand Prix was above all a comparative test of tires. Thus it was that a car fitted with the new device was able to win over more powerful cars which were dependent upon the usual method of repairing tires. A description of this rim will be found in the current SUPPLEMENT. It is a very useful device, especially for high-speed racing. We hope to see it fitted to some American cars in the coming Vanderbilt race.

Out of thirty-four cars entered in the race, but thirty-two started. Of these, nine only were foreign cars, six being Italian and three German. The cars were started at minute-and-a-half intervals, and one at least covered a first round at a rapid rate, the time of this French machine being 52 minutes and 19 seconds, which is equivalent to a speed of 74 miles per hour. Accidents and breakdowns came thick and fast, and more cars dropped out during the third round than in any other round of the race. One French machine overturned while its driver was trying to pass another car on a boarded-over portion of the road, due to the car's running off the boards and dropping into the sand. In some marvelous manner the driver escaped with his life, although he was pinned under the steering wheel as the car rested on its side. A mechanic was thrown twenty yards, but was merely bruised. One make of French car was fitted with wire wheels having very light spokes. In rounding a corner one of the rear wheels collapsed and the car was overturned, but without injuring the driver. Aided by his mechanic, he pluckily fitted no less than twenty spokes to the wheel and made a fresh start. Leaky radiators, cracked cylinders, flattened rims, and broken gear boxes, water pipes, and grease pipes, ended the careers of fifteen of the cars before the finish of the first day's race. The total distance of 384.44 miles was covered in the remarkable time, in view of the new regulation requiring the driver to make his own repairs, of 5 hours, 45 minutes, 30 2-5 seconds, or at an average speed of 66¾ miles an hour. The winner was Szisz on a 105-horse-power French Renault car. A Clement-Bayard driven by young Clement was second in 6 hours, 11 minutes, 40 3-5 seconds; while Nazzaro, on an Italian Fiat, was third in 6 hours, 26 minutes, and 53 seconds. The average speed of the second and third cars for this half of the race was 62.1 and 59.66 miles an hour respectively.

In the second day's race the competitors started at the same intervals at which they arrived the day before. Immediately after the start each competitor was obliged to fill up his tanks with gasoline and oil. The worst accident of the race occurred on this day, through the overturning of one of the French cars, presumably from the breaking of the frame. The frame of a similar car collapsed during the first day of the race, and it is supposed that some similar accident caused the upset of the car just mentioned. Its driver was badly injured, sustaining a broken thigh and several fractured ribs. The third of the wire-wheeled cars had a steering wheel break, and ran off the road just as the other two had done, and one other French car, of the same make as the winner, overturned during this stage of the race. Szisz had maintained his lead throughout the entire second half of the race, and when he completed this half in 6 hours, 28 minutes, 36 3-5 seconds, there was great rejoicing. His total time for the 768.89 miles was 12 hours, 14 minutes, and 7 seconds, which corresponds to an average speed of 62.84 miles an hour. Nazzaro finished second, beating Clement by 3 minutes only. Their respective times were 12:46:26 2-5 and 12:49:46 1-5. These times correspond to average speeds for the entire race of 60.2 and 59.9 miles an hour. The only team to finish was the one consisting of three Brazier cars. One of these took fourth place in 13 hours and 54 minutes, corresponding to an average speed of 51.9 miles an hour. This make of car, it will be remembered, won the Gordon Bennett race both in 1904 and 1905. These races were notable for steady running, although the average speed maintained was not great.

The Grand Prix race has demonstrated the futility of attempting to build a car of tremendous power and comparatively light weight. Such a machine serves merely the grewsome purpose of imperiling its driver's life. If these high-speed races must be run—and they seem to be a necessity to appease the craving for sport—some other method of classification than by weight must be devised in the future. Either the piston displacement or the cylinder capacity would serve as a good standard. At all events, some method should

be procured whereby no sacrifice would be entailed for lightness.

The race for the Vanderbilt cup will be run this year on Long Island on October 6, and will be the only real international race of the year. At least four countries—France, Germany, Italy, and America—will be represented by five cars each. The rules governing the race will be practically the same as heretofore, and the course will be nearly the same as that of last year.

In contrast to the races just mentioned, there is now being conducted in this country and Canada the third annual tour of the American Automobile Association, which includes the contest for the Glidden trophy. This trophy is awarded annually to the touring car which makes the best performance in a 1,000-mile tour. Contrary to what was the case last year, the present contest is being conducted with some resemblan reliability run. The cars are required to make an average speed of nearly 20 miles an hour, and checking stations are located every 25 or 30 miles apart. No repairs, adjustments, or replenishments are allowed in the garage, but these must all be made during the cars' running time. While such a rule does very well for a high-speed race, in the present instance it tends to incite racing. This is not what is desired. Furthermore, the penalization of all cars that do not pass the checkers and arrive each day at the specified times, has not had the effect of stopping racing on the part of the contestants. This was shown on the first day's run of 135 miles from Buffalo to Auburn, New York. The contestants invariably reached the vicinity of the checking stations a considerable length of time in advance. They would then wait until the exact minute when they were due before they would pass the checker. From the working of this system during the first day's run, it would seem that a better way to attain uniform speed on the part of the contestants would be to oblige them to follow a pacemaker provided with an accurate speedometer. This would effectually stop all racing, save on the part of cars which broke down, and were obliged to make up time, if possible. A test of this character should be made to give all the information possible to be obtained from the actual running of cars under touring conditions. Official observers should be provided, and an accurate record kept of all stops, breakdowns, repairs, fuel and oil consumption, tire trouble, etc. With a loss of a specified number of points for all such happenings, it would be an easy matter to pick out the winning car. Besides this there would be considerable valuable information obtained regarding the different makes of cars, both domestic and foreign. In the present event but five foreign cars figure. While light cars are not excluded, they are decidedly in the minority. Almost all of the cars are of the four-cylinder type, and there is one new six-cylinder model of a type which will be marketed next year.

The result of the first day's run was the disablement of three of the cars, owing, it is said, to the roughness of the course. One of these broke its rear axle, another broke a spring, and the third gave out from some cause not as yet recorded. One of the steam cars of a well-known make was burned, owing to its catching fire while the gasoline tank was being filled. This accident was no doubt due to gross carelessness, as the make of car in question is well known for its reliability. Of the 69 starters, only 8 were absent at the end of the second day's run. Out of 51 contestants, 20 had perfect scores.

## AN ELECTRIC EXAMINATION OF EUROPEAN MINERAL WATER.

An electrical method of estimating the proportion of mineral matter contained in spring water has been devised by M. F. Dienert, of Paris, and presented to the Académie des Sciences. The subterranean water encounters soluble elements in the soil, and the solubility is increased by the presence of carbonic acid. Thus carbonate of lime and silica, which are but slightly soluble in pure water, are much more so in presence of the gas. In a given soil and for a certain pressure of carbonic acid gas, the underground waters contain a determined proportion of dissolved bodies, and we may estimate the average amount by means of the electric conductivity, using for this purpose the Kohlrausch method, which has already been used here. For several years past M. Dienert has been employing this method in order to follow the daily variations in the composition of the springs which supply the city of Paris. Thus we have a good check upon the variations in the mineral matter, and if these are great, we afterward seek the causes. The electric method is much more sensitive than chemical analysis. In cases where we find 50 ohms variation in electrical resistance, this being very clearly shown in the Kohlrausch apparatus, for the same water chemical analysis gives uncertain results, seeing that they fall within the limit of error. As an example, we may mention the values of the resistances of some of the springs which supply the city. The Breuil spring, for instance, has had about a uniform value, except in times of freshets, during the last three years, and its resistance is maintained very closely between 2,695 and 2,720 ohms. The Dhuys spring keeps between 2,120 and 2,140 ohms, while the Lunain spring lies between 2,350 and 2,375 ohms. Thus we find that some springs have a very constant mineral value. It is to be remarked that all these springs are very pure and usually contain colon bacilli when their resistance remains constant. Variations of the latter may be traced to different causes, such as were observed for several years past. These causes are due either to changes in the underground condition or again to the infiltration of surface water.

## A KEROSENE-OIL LAMP.

Experiments with a new lighting system have been carried out in Scotland, in which kerosene oil is used. The oil is stored in a tank, which is accommodated in the base of the standard carrying the lamp. In the top of this reservoir is a cylinder filled with compressed carbonic-acid gas, with a small oil container at the bottom holding from one-half to two gallons of oil, which automatically flows thereto from the larger receptacle. A reducing valve connects the oil container with the carbonic acid gas cylinder, and a fine tube leads to the burner, which has a vaporizer consisting of a jet and an air-mixing chamber, while the burner is fitted with an incandescent gas mantle. The oil is forced from the oil container to the vaporizer through the fine tube by the pressure of the carbonic-acid gas. On reaching the vaporizer the oil is converted into gas and passes through the flame spreader, where it combines with the air, and thence to the incandescent mantle. The lamp is economical in consumption, a light of 200 candle-power being obtained for 45 hours with a consumption of one gallon of oil, and the light is clear, bright, and of great penetrative power.

## INDUSTRIAL ALCOHOL: HOW IT IS MADE AND HOW IT IS USED.

The development of the use of denaturized alcohol for industrial purposes has probably reached a higher plane in the German Empire than in any other country. It took its rise from the fact that Germany is dependent upon outside sources for its supply of petroleum and petroleum products. When the explosive motor came into general use for governmental and military purposes, the German government realized that in case of war it might be shut off from these sources of supply, and that, therefore, it was advisable to procure a substitute for the mineral hydrocarbon fuel. With the active co-operation of the German Emperor, the growth of the alcohol industry for commercial purposes was both rapid and widespread. The government encouraged the invention and manufacture of alcohol motors for stationary and automobile purposes, of illuminating devices, cooking utensils, and other apparatus employing alcohol as a fuel. Extensive laws regulate the production and use of denaturized alcohol, and for several years it could be obtained in large quantities and at low cost. Unfortunately, the alcohol industry in Germany to-day has gradually come under the control of a trust and, in consequence, the prices have risen so rapidly that many of the benefits arising from the untaxed alcohol system have been lost. In France, England, Austria, Belgium, and other countries, the use of denaturized alcohol is extensive and it is employed in thriving and valuable industries, regulated by wise laws to safeguard the public and to prevent fraud. The passage of the free-alcohol bill in this country promises much good, and as very little is known regarding the subject on this side of the Atlantic, we must draw from the knowledge of the European manufacturers and users for information upon the product.

During the height of the interest aroused among the public in the earlier phases of the denaturized alcohol propaganda in Germany, the press of many countries was full of accounts concerning the sources from which alcohol might be derived, and an apparently authentic account was at one time circulated, in which it was stated that large quantities were produced from such substances as peat and garbage. It appears, however, that alcohol is not made on an industrial scale in Germany from peat or from garbage of any kind. Aside from the small amount that is produced for drinking and medicinal purposes from prunes, grapes, cherries, and other fruits, the great sources of alcohol for industrial and other uses are potatoes, grain, and the molasses derived as a secondary product from the manufacture of beet sugar. The crude molasses left as a refuse product of the raw beet-sugar manufacture contains from 40 to 50 per cent of sugar which cannot be crystallized, and this can also be utilized as a material for the production of alcohol. The spirits distilled from grain and molasses and the small quantities made from cherries, grape-must, plums, etc., are used mainly for drinking and the manufacture of medicines, perfumes, vinegar, and various other food preparations. The great source of industrial alcohol is from potatoes, and it is used for heating, lighting, and motor purposes, and for a vast number of applications in chemical and industrial manufactures. An interesting consular report from Maracaibo states that successful attempts have recently been made to produce alcohol from the hitherto useless bulb or husk inclosing the coffee bean. Should this report prove true, the alcohol industry will have received a new and vast source of supply, which will prove of great value, especially in coffee-growing countries.

Alcohol may be produced from substances containing sugar, or from those containing starch which may be converted into sugar. It may be similarly derived from cellulose, for instance, in the destructive distillation of wood, which results in the production of wood alcohol and various other substances. It can be obtained by distillation or by fermentation, but usually results from a combination of both. In making spirit from beets, sulphuric acid is used during the fermentative process, which is effected by adding yeast to the *wort*. The latter is the result of a process of saccharifying the starch in the substance undergoing distillation. The alcohol results from the decomposition of sugar, which by the process of fermentation is resolved into carbonic acid and alcohol. Sugar is, therefore, the direct source of alcohol, and for this reason sweet vegetables and fruits may be converted into spirits. The starch is readily converted into sugar by means of the substance called *diastase*, which is found in malt and in germinating seeds generally. It is for this reason that starchy vegetables, such as potatoes, as well as sweet vegetables, may be used in the manufacture of spirits. In using starchy vegetables, however, the intermediate process mentioned above of saccharifying the starch, technically known as *mashing*, is necessary. This consists in mixing the raw grain, or other substance, properly ground, with malt and with water at a temperature of about 150 deg. F. In using potatoes these are usually steamed before the malt is applied, for they contain a much smaller proportion of starch than the cereals, and by steaming the starch cells are thoroughly broken and the starch is reduced to a condition in which it is easily acted upon. The saccharine infusion resulting from the *mashing* is that technically known as the *wort*.

The fermentation is effected by adding either brewer's or compressed yeast to the *wort*, or to a saccharine liquid obtained from molasses, beets, or other sugar-producing fruits or vegetables. The fermentation process is carried to its furthest limit in order to produce the greatest amount of alcohol, and the liquid thus prepared for distillation is technically known as the *wash*. The *still* is the apparatus in which the wash is reduced to vapor and then condensed. Essentially and in its oldest form, the *still* consists of a copper vessel provided with a closed head and connected with a spiral tube called the *worm*. The latter is cooled by means of circulating water or refrigeration, and when the heat is applied at the still the spirit begins to rise in vapor along with more or less steam, and passes through the worm, where it becomes condensed by the cold, and trickles down into the *receiver*. The product of the first distillation is impure, and redistillation at a lower temperature is necessary to deprive it of the water and of the oils which have passed with the alcohol. To-day, by means of fractional stills the process has been greatly improved, and the alcohol may be obtained cheaply and of a high grade.

The industrial uses of alcohol are many and varied, as was demonstrated by an exhibition in Germany a few years ago, which was devoted exclusively to alcohol, its production and its uses for industrial purposes. While the general use of alcohol for industrial purposes, heating, lighting, and a vast range of chemical and other manufacturing purposes has steadily increased in Germany, the percentage of the whole product that is used for motor purposes is relatively small and, so far from increasing, is said to be rather diminishing, though to just what extent it would be difficult to prove. A few Germans, from patriotic motives, use alcohol for driving automobiles, freight wagons, motor boats, and farming machinery. It has been found by elaborate tests that the economy of alcohol as a fuel for gas motors is largely increased by its being carbureted through admixture with a certain percentage of benzole or other product of mineral oil. For a time it was believed that this admixture of benzole could not be safely carried beyond 20 per cent, but more recent experience has shown that a mixture of equal parts of alcohol and benzole can be used, especially in large motors, with entire safety and economical results. For automobile purposes the usual proportion is now about 30 per cent of benzole or gasoline, but at the previous cost of alcohol it could not compete on the score of economy with mineral hydrocarbons in a country where they were either produced or imported free of duty.

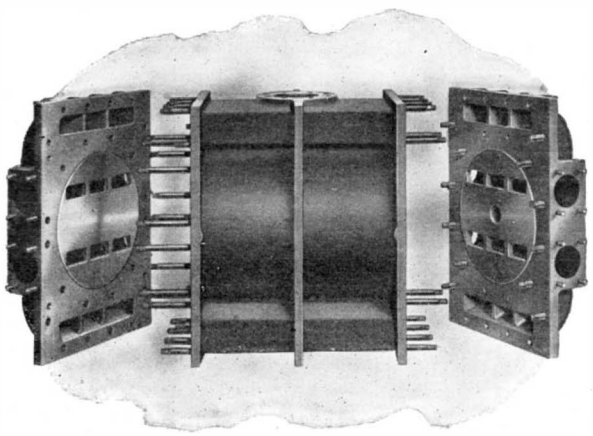
The industrial applications of alcohol are numerous; the chemical industries lead. Of these, the manufacture of vinegar from alcohol and acetic acid is one of the most important. This industry is mainly the growth of the period since 1887, and its extent may be

(*Continued on page 46.*)

### AN ADVANCE IN STEAM ENGINE DESIGN.

In meeting the invasion of the power field by new prime movers and long-distance electrical transmission of water power, the steam engine has held its own, and has even increased its field of usefulness by rapid improvement in both efficiency and simplicity. One of the best examples of this new era of progress in steam engineering is the new Atlas four-valve engine manufactured by the Atlas Engine Works, of Indianapolis.

In the effort to produce an engine that would be simple, durable, and highly economical of steam, the



THE FOUR-VALVE ENGINE CYLINDER.

Atlas designer has turned for economy to the Corliss principle of separate, semi-rotating valves for inlet and exhaust, and has improved on the Corliss economy by placing the valves directly in the cylinder heads, thus giving the shortest possible steam passages, the least possible condensation, and the lowest clearance, while he has lost but little of the economy by stripping the gear of all such complications as dash-pots, wrist-plates, governor cams, crab-hooks, and rocker-arms with their offsets and lost motion. A shaft governor is used, and the two steam valves are operated by one rod directly from an eccentric, which is a part of this shaft governor.

The two exhaust valves are operated by a rod from an eccentric which is keyed to the shaft. The operation is thus as thoroughly simple as that of the slide-valve engine, and experience has shown that it is no more likely to get out of order, and requires no more expensive attendance, than does the ordinary automatic single-valve engine.

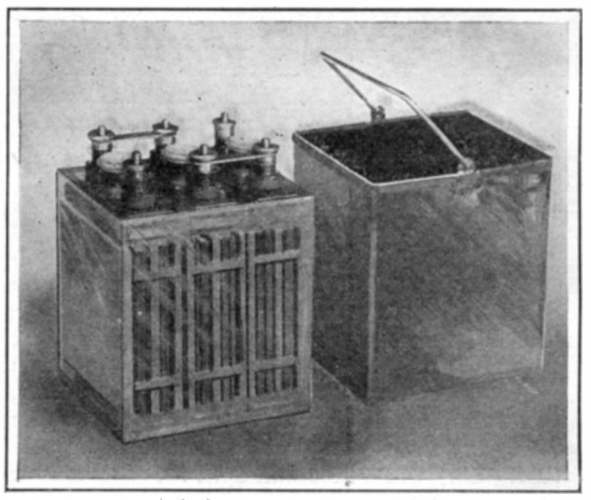
Exhaust valves have always been operated in this way on the Corliss, and it has been demonstrated by the Atlas that with a shaft governor that is just right and correctly proportioned valves and ports, backed by the nicest accuracy of workmanship, a cut-off practically as precise and a regulation as close, can be had with this simple four-valve construction as with the delicate and complicated mechanism of dash-pots and releasing gear that is essential to the Corliss.

The engine has removable journals and is built in sizes varying from ten-inch to twenty-six-inch cylinders, in both self-contained and side-crank forms of transmission, with splash or sight-feed oiling systems. The speed range recommended runs from 125 to 250 revolutions per minute according to the size of cylinder and length of stroke, and the engine finds its field of usefulness limited only by its speed limits.

### AN IMPROVED LIGHT-WEIGHT IGNITION STORAGE BATTERY.

Our illustration shows the general appearance of a new light-weight ignition cell put up in celluloid jars by the Müller Porous Plate Accumulator Company, 205 West 41st Street, this city. The battery illustrated consists of three 5-plate cells having a capacity of 25 ampere-hours, and furnishing a total of 6 volts. The cells and containing case complete weigh only 12 pounds, which is extremely light for a battery of this voltage and capacity. The battery shown was constructed especially for use on a flying machine, but the greatest sphere of usefulness for cells of this kind is on automobiles. Not only are these batteries of about half the weight for the same capacity of cells used heretofore, but the plates are constructed after a special process which gives them great porosity and a long life. They can be charged and discharged a large number of times, and at a high rate, without injury, and, what is more important with an ignition cell, they can be left standing in a discharged condition for a long time without any loss of capacity. In other words, abuse of this character, which would completely ruin some of the light-weight foreign ignition cells, will cause no perceptible difference in the efficiency of this improved battery. The capacity, unlike that of most ignition accumulators, is fully equal to the rating.

Two 50-ampere-hour cells giving 4 volts, for example, weigh only 16 pounds, and yet they will be found sufficient to run a four-cylinder car at least 1,200 miles. Comparing these figures with those of other ignition cells, it will be seen that, durability aside, the battery is a decided advance over what has been done before as regards light weight.



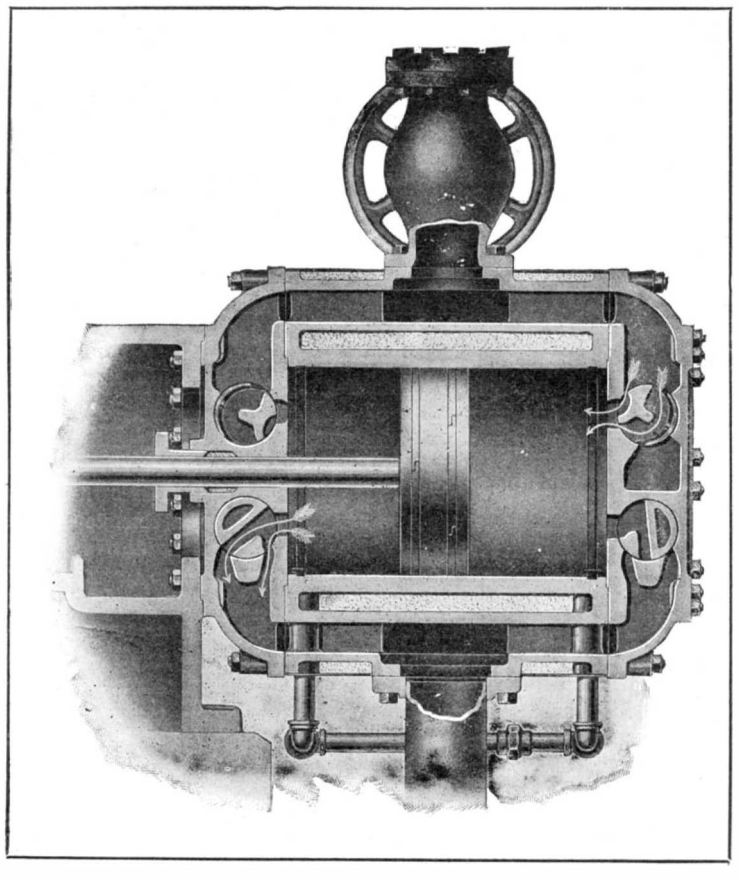
IMPROVED LIGHT-WEIGHT IGNITION STORAGE CELLS.
Voltage, 6. Ampere-hours, 25. Weight, 12 pounds.

### A NEW ADJUSTABLE FLOAT-FEED CARBURETER FOR USE WITH GASOLINE OR ALCOHOL.

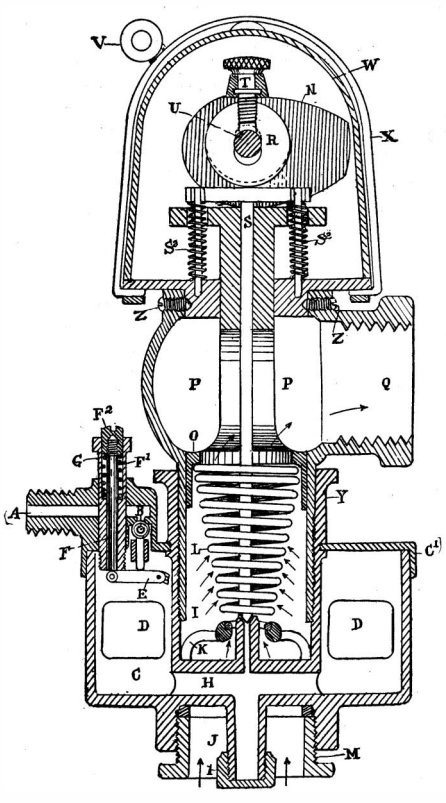
The accompanying cut gives a longitudinal section of a new adjustable carbureter, which has a novel feature in the form of a coil spring, that acts as a throttle in connection with a slightly movable needle valve placed in the spraying nozzle. As can be readily seen, the mixing chamber of the carbureter is located in the center of the float-feed chamber. The main air supply enters through the pipe, *J*, placed below a spider, *K*, that surrounds the spraying nozzle. *J* is threaded in the bottom of the float chamber, so that it can be screwed up and made to raise the spider, *K*, to a greater height, if necessary. Above the throttle spring, *L*, there is placed a slidable piston, which extends upward and ends in a flanged top above the carbureter. This piston is bored out in the center, to allow of the passage of the mixture from the interior of the spring, *L*, through to the chamber, *P*, and connecting pipe, *Q*, which leads to the inlet pipe of the motor. Passing downward through this piston, and terminating in the spraying nozzle, *I*, is a needle valve, *S*, for regulating the quantity of fuel drawn from the spraying nozzle. This valve is supported upon two coiled springs that surround studs, $S^2$, in the flange on its top. An eccentric, *R*, mounted between two cams, *N*, on a shaft, *U*, above the piston and needle valve, is used to control the movement of the latter. The throw of this eccentric is varied by a thumb screw, *T*, and is very slight. A lever, *V*, on the shaft, *U*, rotates the cams and eccentric, thus depressing both the piston, *O*, and the needle valve, *S*, at the same time, and in a given ratio. As *O* descends it compresses the spring, *L*, closing together the large top coils first and the stiffer bottom coils (which are farther apart) last, if it is fully compressed. The result is that, as the needle valve is closed down, the passage of the air around it is made smaller, thus increasing the suction and causing the ratio of air and fuel to be kept constant. The result is that the engine can be throttled down to a great extent, or speeded up as high as possible with a practically perfect mixture throughout the entire range. There is no possible chance of the carbureter getting out of order from the weakening of the spring, as the action of the latter is not depended upon to control the mixture. The carbureter is, consequently, not automatic in the ordinary sense of the term, but it is far simpler and surer in its action than any of the automatic carbureters that have so far been produced. When once the needle valve and throttle spring have been set to produce the proper mixture, there is no chance of their being disturbed.

The circular cork float, *D*, is suspended by a flexible wire link from the lever, *E*, pivoted on the bottom of the plunger, *F*, which is pressed upward in a tube, *G*, by means of a small spring, $F^1$. By pressing down on cap, $F^2$, this plunger, *F*, can be depressed and made to carry with it the lever, *E*. The small plunger above *E*, which holds the ball valve in place, is thus allowed to drop, the valve opens, and the float chamber tends to fill, thus flooding the carbureter at the spraying nozzle. The adjustment of the fuel level within the nozzle is obtained by raising or lowering the plunger, *F*. This raises or lowers the fulcrum of lever, *E*, and changes the point at which the float closes the ball valve. The float chamber, *C*, is screwed on to the pipe which forms the mixing chamber of the carbureter, and its cover, $C^1$, is locked in place by the jam nut, *Y*. The gasoline connection is made at *A*, and the chamber may be drained by unscrewing the cap 1. *Z Z* are retaining screws for the top of the carbureter, for the purpose of enabling the same to be placed at any desired horizontal angle to the body portion. The cams and eccentric are incased by cover, *W*, which is held in place by the steel spring, *X*.

In a recent demonstration of this carbureter made before our Automobile Editor, the inventor, Mr. B. F. Walker, of Bridgeport, Conn., started the engine cold on wood alcohol. To do this it was necessary to prime the engine with a few squirts of the alcohol, but after it had run a few moments it could be stopped and started without priming. A single-cylinder runabout fitted with a 4¾ by 6-inch engine was found to show considerably more speed when run on wood alcohol in place of gasoline. The combustion was very good, there being but little odor from the exhaust. One of these carbureters is, we understand, being used on an Oldsmobile touring car in the Glidden tour, and it will be interesting to compare the results obtained with it as to fuel consumption with those obtained with the carbureter ordinarily used. The ability to start the engine, when cold, with wood alcohol augurs well for the use of the carbureter in connection with grain alcohol when the new law allowing the use of the latter goes into effect. The demonstration also shows that this design of carbureter is very effective in producing an intimate mixture.



SECTIONAL VIEW OF FOUR-VALVE ENGINE CYLINDER.




A NEW ADJUSTABLE FLOAT-FEED CARBURETER FOR USE WITH GASOLINE OR ALCOHOL.

## THE ENLARGEMENT OF THE ERIE CANAL.

BY DAY ALLEN WILLEY.

The enlargement of the Erie Canal into the New York barge canal, as it is termed, will give an unusual opportunity to test the power and capacity of American excavating machinery, owing to the varied character of the work. It is unnecessary to say that the enlargement is on such an elaborate scale that the present canal will practically be reconstructed where it can be utilized, while a considerable mileage of the new waterway will be excavated over a different route.

The portion of New York State through which the western division of the Erie passes is as different in topography from the eastern portion as the Culebra cut on the Panama Canal differs from the low, flat country at its terminals. When the original channel was constructed, one of the most difficult engineering problems to overcome was the descent from the level of the Mohawk River to the level of the Hudson—a fall of over 120 feet. This was overcome by a series of sixteen locks, which will be replaced by three, each extends over the levee or spoil bank, the lower end reaching beneath the arc described by the shovel arm. On the incline are tram cars, which are drawn along the rails by an endless cable passing around sheaves mounted at the extremities of the incline. The cableway is operated by a stationary steam engine mounted on the lower part of the tipple. As fast as a car is filled by the shovel, it is pulled to the other end of the incline, where by means of a tripper it is automatically emptied, when it is returned to the excavation. The tipple may be provided with parallel tracks, so that an empty car can be run back and filled while a loaded car is hauled up to be dumped. The tipple is mounted on trucks, which in turn rest upon heavy rails. The engine can be utilized to move it along this track as the excavation progresses, the principle employed being the same as that utilized in the bridge tramway plants in service for unloading ore vessels on Lake Erie.

A more elaborate design for removing and depositing the excavated material is about to be placed in service on the work between Rochester and Buffalo. It is also utilized in connection with a powerful steam shovel, and includes an elevated tramway supported by towers also mounted upon movable trucks. Along the tramway passes a single or a series of buckets, which are filled by being lowered under the arm of the shovel and its scoop emptied into them. The receptacles are then hoisted to the level of the tramway, hauled by trolley and cable to the levee or spoil bank, and lowered and emptied. By this method the deposit of the material can be better controlled, and if it is utilized in the foundation of the canal bank, the piling can be done more accurately. With a conveyor of this type both banks of the canal can be built up simultaneously if it is constructed in the prism. Arms or aprons can be projected from each end completely covering the area of the bank. The steam shovel can be installed on a track laid in the ditch between the towers of the tramway, and serve it equally as well as if placed at one end, as shown in the illustration.

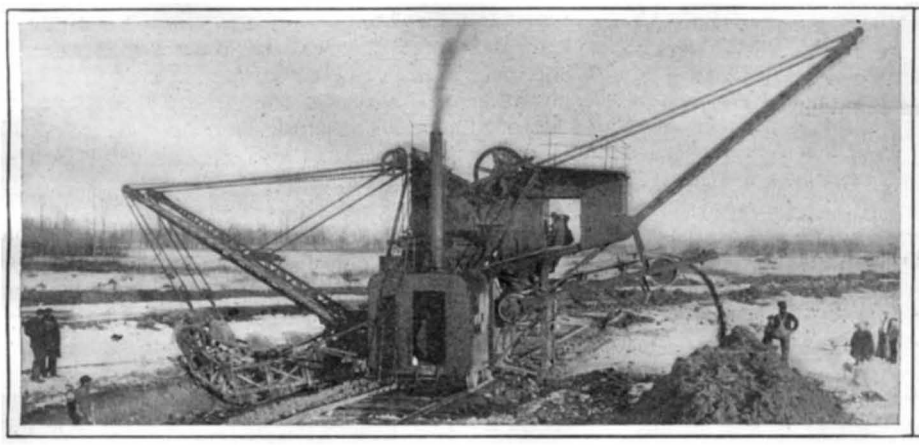
On Contract No. 4, for working on soft material the Lubecker excavator has been placed in service. It is a combination of excavator and conveyor, and travels along a track on the bank beside the canal prism. The excavator consists of a series of heavy steel scoops passing around an arm of steel framework by means of an endless chain. This arm is composed of sections, so that it can be adjusted closely to the formation of the surface, while it can be lifted clear of the ground by a second arm, which is raised or lowered by chains. As the earth is taken from the ditch by the scoops, it is carried inward and dumped upon another conveyor, which moves in the opposite direction and out upon another arm projecting from the other side of the machine. The end of the latter arm is held in position over the bank upon which the material is piled, as shown in the illustration. The capacity of the Lubecker at present in service is about 1,000 cubic yards in a day of ten hours.

An idea of the enormous amount of excavation required to complete the barge canal can be gained, when it is stated that although the distance covered by Contract No. 4 is but 4.83 miles, the material to be removed from it aggregates 2,228,000 cubic yards—enough to keep five steam shovels of 2,000 yards daily capacity employed for over six months, estimating a working day at ten hours. As already stated, however, not a little of the work has been in very hard foundation. West of Rochester cuts have been made through what appeared to be solid rock strata. Much of this is soft enough to be taken out by the steam shovels without the use of explosives.

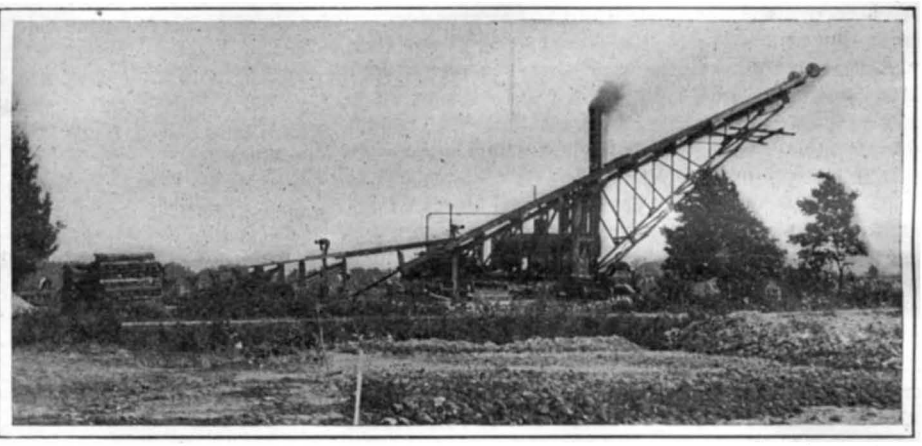
But when one thinks what the canal will become when the task is completed, it may seem worth while. The fact is that the State of New York will have the largest artificial waterway for navigation in the world with one exception, considering the length as well as breadth and depth. It is unnecessary to say that many canals are broader and deeper, but none equal the Erie, which is the main section of New York's canal system, in length. In considering the enlargement, two branches of the Erie are frequently overlooked, but the appropriation of $101,000,000 is intended to cover the cost of improving these as well. They comprise the Oswego Canal, 38 miles long, extending from Onon-

Embankment Thrown Up by Mechanical Excavator.

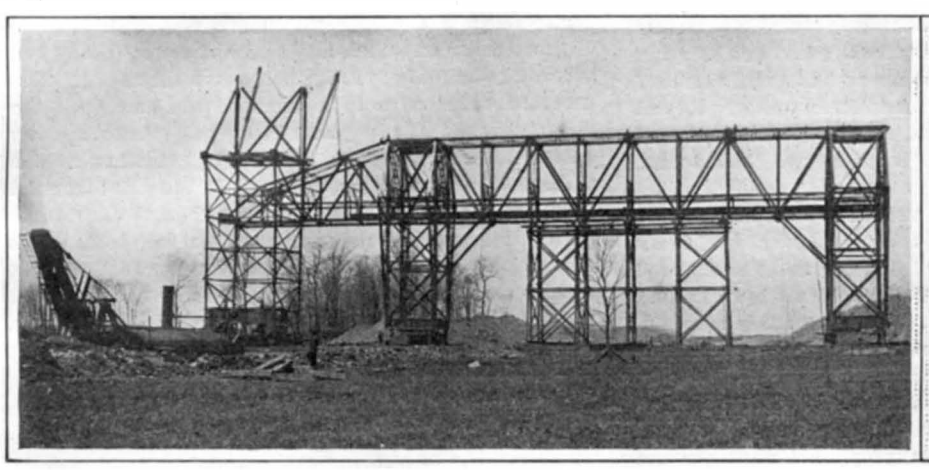
Excavation Partly Completed on Eastern Division.



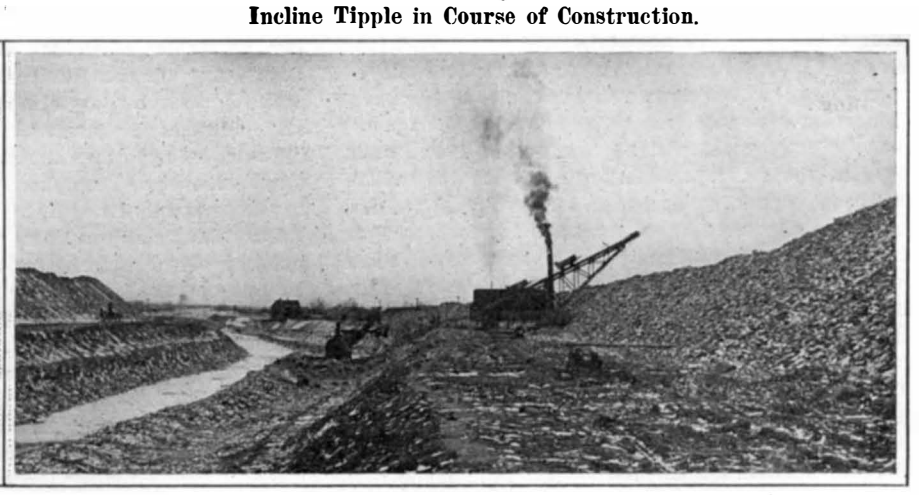
Lubecker Excavating Machine Used on the Eastern Division.



Incline Tipple in Course of Construction.



New Design of Elevated Tramway for Handling Material in Connection with Dredge.



General View of Excavation, Showing Deep Cut Near Rochester.

THE ENLARGEMENT OF THE ERIE CANAL.

having a lift of about 40 feet. Along the eastern division a very large amount of rock cutting will be necessitated, but on these contracts the steam shovel will also be essential, while much excavation through the swamp lands along the route will be performed by suction and probably dipper dredges.

Already some interesting machinery has been installed, especially on Contract No. 6 between Rochester and Buffalo and on Contract No. 4 on the eastern division. Enough work has been thus far performed to give some conception of the great size of the excavation required. While western New York is comparatively level when contrasted with the Mohawk Valley, the country is rolling in character, necessitating several deep cuts on the contract referred to. Up to the present the digging has been performed chiefly by steam shovels equipped with toothed bucket scoops holding from two to five cubic yards. For removing the material as it is taken from the prism, several methods have been employed. One of these on Contract No. 6 is an incline tipple. As the illustrations show, it consists of an elevated tramway, the upper end of which

daga Lake near Syracuse to Lake Ontario at Oswego; and the Champlain, 66 miles long, which furnishes a navigable waterway from the upper Hudson near Troy to Lake Champlain. Each may be called a branch of the Erie for the reason that boats passing through the Oswego Canal enter the main channel by way of Onondaga Lake, while boats from Lake Champlain bound southward and westward enter the Erie near the southern terminus of the Champlain Canal. The value of these branches is indicated by the fact that they furnish the interior of New York State its only water connection with Lake Ontario and the St. Lawrence River; and are the means of considerably swelling the traffic of the main canal, since they also give it a connection by water with Canada.

The main canal and branches will be of uniform depth and breadth on the bottom. Vessels drawing 11½ feet of water can pass from one end to the other of the system, while the width at the bottom will be at least 75 feet. Generally speaking, this means that the main canal will be enlarged to about four times its present transportation capacity. At present the depth ranges from 7 to 9 feet, about one-third of the waterway being of the latter depth, to which it was excavated by the expenditure of $9,000,000 appropriated for this purpose in 1894. When the historic "Seneca Chief," the first boat to carry freight and passengers upon it, made the trip from Buffalo to Albany, the canal was but 28 feet in width on the bottom, 70 feet on the surface, while its average depth was not over 4 feet. The demands of commerce so crowded it with traffic, that only ten years later the New York legislature authorized the enlargement which approximately represents the dimensions of the canal prior to the enlargement of 1895—a work which was not completed until 1862.

The barge of the future, however, will have a cargo capacity of 33 1-3 times the original craft, 22 2-3 times the boats of the period between 1830 and 1850, ten times those in service between 1850 and 1862, and four times as great as the average boat in present use. What is perhaps more significant, however, is the extent of the cargoes which can be shipped at one time by a fleet of tows of the new boats. The majority of the towing vessels are intended as cargo carriers, but provided with engines sufficiently powerful to pull from two to three boats in addition, moving at a rate of from 4 to 6 miles an hour. Thus from 12,000 to 15,000 bushels of wheat can now be transported from Buffalo to New York at a single shipment if desired. The present plan will probably be followed in making up tows for convenience and economy. This means that a single series of barges will carry enough grain to load an ocean steamship of 4,000 tons capacity. A very large fleet of vessels of this kind is plying across the Atlantic in the so-called "tramp" service, for it has been demonstrated that they can be constructed and equipped with engines which make them among the most economical freight carriers in the world. A single barge of the new type will carry sufficient cargo to fill the hold of many of the three-masted schooners in the American coasting trade, while a tow of four would be sufficient to load the largest square-rigged sailing vessel which plies out of New York. If one of the newer transatlantic steamships, which have been especially designed for carrying freight, were to be chartered to take wheat, for instance, exclusively, a flotilla of twenty-five of these canal boats would be sufficient to complete her cargo, or six tows, while two or three barges would carry enough grain to fill the cargo space which is devoted to this cereal on the ordinary Atlantic liner.

The cost of transportation of wheat on the present canal averages 87 cents a ton, or 1.9 mills per ton per mile—a little less than a fifth of a cent. Upon this and other statistics a calculation has been made that when the proposed improvement is completed, the maximum cost of transportation will be 26 cents a ton, or 0.52 of a mill per ton per mile. In other words, the improvement will cut down the cost of transportation to nearly 25 per cent of the average rate at present based on the ton mile. Contrasting this with the cost of railroad transportation, an idea can be gained of the competition which the enlarged waterway will offer land transportation routes. The reports of the principal railroad lines running out of Buffalo show that the average cost of carrying wheat is about 6 mills per ton per mile—three times as much as the present canal rate, and nearly twelve times as much as the rate on the enlarged canal. In other words, one of the newer canal barges would carry a cargo equal to a train of fifty cars at the same cost of hauling five with the locomotive.

The paramount object in the culture of the grape in most parts of the world has been the obtaining of wine. The extent of this will be surprising and hardly believed by those not acquainted with the statistics. Thus, for instance, there are annually produced on the globe over 4,000,000,000 gallons of wine. Of this amount, the United States produces only about 50,000,000 gallons.

## INDUSTRIAL ALCOHOL: HOW IT IS MADE AND HOW IT IS USED.

(*Continued from page 43.*)

estimated from the fact that there is consumed in Germany annually for the manufacture of vinegar 16,000,000 liters (4,224,000 gallons) of alcohol. The oldest application is in cooking. In the new alcohol cooking lamps, some of which are regulatable, the alcohol is gasified before burning. In some the Bunsen principle is used; the alcohol before burning passing through a tube where it entrains with it the necessary quantity of air. For cooking purposes alcohol has great advantages; it is cleanly in application and instantly at disposal. There are also alcohol heating stoves, but they are as yet too dear to come into general use. For lighting, alcohol has only recently been used. The first incandescent alcohol lamp dates from 1895, but was not successful. The Auer lamp is better. It gives 60 to 62 candle-power and burns per hour about 13 quarts of alcohol, but has the disadvantage of requiring a permanent gasifying flame. The Helft lamps do their gasifying without a special flame, and if kept clean and in good condition give no trouble. The cost of light is 30 per cent cheaper than with petroleum. There is, however, this objection, that it takes 1 to 1½ minutes to get the flame going. Other excellent lamps adapted for the use of alcohol are in operation in Germany to-day, such as the Phoebus and the "Bogenlicht."

The use of alcohol for motors is recent. Experiments by Prof. Ernst Meyer show that the alcohol motor has a thermic efficiency of 39½ per cent, a result excelled only by the Diesel among motors using liquid fuel. The reason for this is that alcohol, containing as it does 8 to 9 per cent of water, permits a high grade of compression, without danger of premature ignition. As alcohol is not so rich in carbon as petroleum and benzine, it burns more cleanly. Prof. Meyer obtained from a motor of 20 effective horse-power a consumption as low as 8.8 pounds of 90 per cent alcohol with full load. Per horse-power per hour this cost is one cent; and the alcohol, giving only 5,600 heat units, was compared with petroleum, which gives 10,000 to 11,000. An important advantage of alcohol, which applies specially to its use in motor carriages and in engines for operating creameries and small manufacturing plants in premises adjacent to dwellings, is its absolute cleanliness and freedom from the mephitic odors which render hydrocarbon engines so offensive to many people.

The following list of the industrial uses of alcohol in England must be regarded rather as indicative than comprehensive, since the spirit is now used in a very great variety of ways in the numerous industries: Artificial lubricants, furniture polish, finish, varnish, lacquers, enamels, celluloid, zylonite, gunpowders, aniline colors, dyeing and preparation of colors, dissolving resins for hat makers, collodion, goldbeaters' skin, filling spirit levels, floating mariner's compass, extracting vegetable alkaloids, making vegetable extracts (dry), manufacture of transparent soap, quick-drying paints, preserving objects of natural history, chemical and anatomical research, sulphuric ether, chloral hydrate, chloroform, fulminating powder, liniments of soap, compound camphor, aconite and belladonna, hypersperm oil, etc.

For industrial purposes, and to render alcohol impossible of consumption as a beverage, the spirit may be either methylated or denaturized. Methylated means the addition of wood alcohol (methyl alcohol) to the spirit (ethyl alcohol). Wood alcohol is a poisonous substance, and at the same time possesses an extremely disagreeable taste, which renders it impotable. The denaturization of alcohol signifies the addition of such substances other than, or together with, wood alcohol, which render the ethyl alcohol unfit for use as a drink. The following are some German methods of rendering alcohol impotable:

I. Complete denaturization is accomplished by the addition to every 100 liters (equal to 26½ gallons) of spirits:

(*a*) Two and one-half liters of the "standard denaturizer," made of 4 parts of wood alcohol, 1 part of pyridin (a nitrogenous base obtained by distilling bone oil or coal tar), with the addition of 50 grammes to each liter of oil of lavender or rosemary.

(*b*) One and one-fourth liters of the above "standard" and 2 liters of benzole with every 100 liters of alcohol.

Of alcohol thus completely denaturized there was used in Germany, during the campaign year 1903-4, 931,406 hectoliters denaturized by process (*a*), as described above, and 52,764 hectoliters which had been denaturized by process (*b*). This made a total of 26,080,505 gallons of wholly denaturized spirits used during the year for heating, lighting, and various processes of manufacture.

II. Incomplete denaturization—i.e., sufficient to prevent alcohol from being drunk, but not to disqualify it from use for various special purposes, for which the wholly denaturized spirits would be unavailable—is accomplished by several methods as follows, the quantity and nature of each substance given being the prescribed dose for each 100 liters (26½ gallons) of spirits:

(*c*) Five liters of wood alcohol or one-half liter of pyridin.

(*d*) Twenty liters of solution of shellac, containing 1 part gum to 2 parts alcohol of 90 per cent purity. Alcohol for the manufacture of celluloid and pegamoid is denaturized.

(*e*) By the addition of 1 kilogramme of camphor or 2 liters of oil of turpentine or one-half liter benzole to each 100 liters of spirits. Alcohol to be used in the manufacture of ethers, aldehyde, agarcin, white lead, bromo-silver gelatins, photographic papers and plates, electrode plates, collodion, salicylic acid and salts, aniline chemistry, and a great number of other purposes is denaturized by the addition of—

(*f*) Ten liters sulphuric ether, or 1 liter of benzole, or one-half liter oil of turpentine, or 0.025 liter of animal oil.

For the manufacture of varnishes and inks alcohol is denaturized by the addition of oil of turpentine or animal oil, and for the production of soda soaps by the addition of 1 kilogramme of castor oil. Alcohol for the production of lanolin is prepared by adding 5 liters of benzine to each hectoliter of spirits.

The whole amount of incompletely denaturized alcohol of the several grades above described which was consumed in Germany last year was 385,946 hectoliters, equal to 10,227,569 gallons. In addition to all the foregoing, 21,779 hectoliters of alcohol were used duty free and without denaturization of any kind for governmental or public purposes, such as hospitals, government laboratories, and for the manufacture of fulminates and smokeless powder.

### Testing the Size and Heat of High-Tension and Low-Tension Ignition Sparks.

In a recently published article on ignition systems for gasoline engines, that well-known expert, Mr. Charles E. Duryea, gives the following interesting test for showing the efficiency of the contact and jump spark. It is a fact that with the contact or make-and-break spark a much smaller lead is required with any engine than must be used if the engine is equipped with the jump spark. The reason for this becomes apparent after one has made the experiment described by Mr. Duryea.

"Pass a strip of paper between the points of a jump spark plug and the paper will be perforated by the sparks, leaving a line of minute holes. To get the actual size of the spark in the cylinder the points should be separated ¼ inch or more, for it is well known that the compressed air is an insulator, and that engines which frequently miss on full charges will fire regularly when throttled, thus proving that there is a larger and better spark when there is no compression.

"To test the make-and-break spark in a similar manner, connect one wire from such a system to a piece of sheet metal on which is placed a sheet of thin paper, preferably held about 1/32 inch above the metal. Connect the other wire to a common pin and push the latter through the paper. Then pull the pin away quickly. A large spark will follow, burning a hole through the paper, frequently ⅛ inch in diameter. Compare the area of this hole with that of the minute perforation made by the jump spark, remembering that the make-and-break spark is also longer, and it will be seen that the volume and heat of the make-and-break spark is much larger, on which account it will fire a less perfect mixture."

### The Current Supplement.

The current Supplement, No. 1594, contains an unusual number of striking articles and papers. Among the more important may be mentioned the splendid address of Mr. S. S. Wheeler on Engineering Honor. Mr. John M. Thomson's paper on the Chemistry of Artists' Colors in Relation to their Composition and Permanency is concluded. The last installment of Mr. Dugald Clerk's paper on Internal-Combustion Motors is likewise published. Probably few people ever stop to think what a wonderful organ a bird's bill really is. Mr. B. S. Bowdish, in an instructive and pleasantly-written article, explains the various functions which the bills of different birds must perform. A valveless air pump is described by the Berlin Correspondent of the Scientific American. Atmospheric electricity in trees is the subject of an exhaustive paper.

The specific gravity of non-conducting materials is in many cases of vital importance. For marine work, especially, take, for instance, a steamer of the size of the "Teutonic," of the White Star Line, the difference in weight of the covering applied, which was of low specific gravity, effected a saving of over 100 tons in weight. If the work had been done with high specific gravity material, says Mr. Ashby W. Warner in a paper on "Non-conducting Work," read before the Cleveland Institute of Engineers, this steamer would have carried over 100 tons dead weight more than was necessary.

# Correspondence.

### Ovid and Land Reclamation.

To the Editor of the SCIENTIFIC AMERICAN:

I lately chanced to come across the following passage in Ovid, which as it records one of the earliest instances of land being reclaimed for building purposes within the boundaries of the city of Rome, may prove of more than passing interest to some of your readers at a time when such schemes are being very widely considered, both in this country and in Europe. I may add that to me it appealed strongly, from the fact that it seemed to bear a striking analogy to the plan which through your courtesy I proposed in the columns of the SCIENTIFIC AMERICAN of July 9, 1904, for dealing with the East River by means of a process of dyking and filling in, though of course on a very much lesser scale.

I have added a free translation of the passage for the benefit of the general reader.

"Forte revertebar festis Vestalibus illac,
Qua Nova Romano nunc via juncta Foro est
Huc pede matronam vidi descendere nudo:
Obstupui, tacitus sustinuique gradum.
Sensit anus vicina loci, jussumque sedere
Alloquitur, quatiens voce tremente caput.
Hoc, ubi nunc fora sunt, udoe tenuere paludes:
Amne redundatis fossa madebat aquis.
Curtius illelacus, siccas qui sustinet aras,
Nunc solida est tellus, sed lacus ante fuit.
Qua Velabra solent in Circum ducere pompas,
Nil proeter salices crassaque canna fuit.
Soepe suburbanas rediens conviva per undas
Cantat, et ad nautas ebria verba jacit.
Nondum conveniens diversis iste figuris
Nomen ab averso ceperat amne deus.
Hic quoque lucus erat juncis et arundine densus
Et pede velato non adeunda palus.
Stagna recesserunt, et aquas sua ripa coërcet:
Siccaque nunc tellus. Mos tamen ille manet."
—Fasti vi., 395-414.

TRANSLATION.

"I happened to be returning from the festival of Vesta by that road which the New Street takes toward the Forum of Rome. I saw a woman here walking along barefooted. I was naturally astonished, and stopped to watch her. An old woman of the neighborhood noticed me, and bidding me be seated, addressed me thus, her wizened head shaking with a convulsive cough: This spot, where now you see the markets, was once occupied by marsh lands; a ditch used to pass this way full of water from the river's overflow. Yonder was the Curtian Lake, where now the churches stand on dry ground. It is now a firm foundation, but formerly it was nothing but a lake. At the point where the two Velabran streets pass into the Circus, there was nothing at that time but willows and coarse reeds. Often the reveler on his way home through the waterways of the outskirts would sing to himself and bandy drunken jokes with the watermen. The god who assumes different forms occasionally—Vertumnus—had not yet been christened after the river's diversion. Here too was a cemetery with bulrushes and osiers on one side and a swamp not to be crossed with shoes on. The stagnant pools have been drained, the river's bank now confines the stream, and the ground is dry; but the custom of taking off the shoes is still kept up." T. F.

Philadelphia, June 9, 1906.

### The Recent Earthquake in California.

Dr. J. C. Branner, vice-president of the Leland Stanford, Jr., University, made an interesting address on the above subject at the late special summer Ithaca meeting of the American Association for the Advancement of Science.

As to the relation of earthquakes to the interior of the earth, he stated that the old idea that the earth has a fluid interior has now been entirely abandoned. It is now believed that the earth is solid throughout, with the exception of scattered local pockets of molten matter; hence it does not seem as if there could be any direct connection between earthquakes and volcanoes. All the geological strata (meaning, of course, those of plastic origin) were originally deposited horizontally, but they have been squeezed together, and thus compressed so as to tilt them and fold and break them at the surface. This tilting diminishes as we descend, till at a certain depth, probably about six miles, the superincumbent pressure is so great that the strata cannot bend and the pressure is taken up in plasticity. A good illustration of this is found in the coal fields of Pennsylvania, where the seams of coal run more and more nearly horizontal as we descend. Faults and displacements are near the surface—and faults imply earthquakes.

There are two classes of disturbances—volcanic and tectonic, i. e., produced by pressure. When you overload a portion of the earth's surface it cracks, and the resulting shock is not conveyed in circles, but in irregular curves according to the conductivity of the rocks and the length of the line of fracture along which slipping occurs.

Faults occur in the Coast Range between the Santa Clara Valley and the Pacific Coast, which indicate a displacement of 3,000 feet, i.e., the strata on one side of the fault line are of a geological depth of 3,000 feet below those on the other.

Soon after the earthquake, Dr. Branner went out and looked at this crack. It could be traced 185 miles in a northwesterly and southeasterly direction from Point Arena on the coast northerly from San Francisco down through Tomales Bay, passing eight miles west of San Francisco, thence coming ashore again, proceeding along the coast and partly going inland, following nearly a straight line. The trouble came from this crack. The waves radiating out from it constituted the earthquake.

California is characterized by many parallel ranges of valleys near the coast, produced by overturning or faulting of nearly flat strata. These faults when made must all have caused earthquakes. The principal movement in the last earthquake was not vertical, but lateral, and varied from a few inches up to sixteen feet, while the vertical displacement was generally only a few inches, and nowhere more than two or three feet. The slightness of this vertical displacement explains the absence of a tidal wave.

He admitted his inability to explain the records of the seismograph. He characterized them as a higgledy-piggledy set of curves.

Fortunately, most people were in bed at the time of the earthquake; otherwise, the mortality would have been much greater. Among the singular effects of the earthquake, was that it turned pictures completely around in some cases, so as to face the wall where they were hanging. There were many landslides in the country where the soil was moist. No well-built house was shaken down except those on made land.

Dr. Branner accompanied his remarks with numerous lantern illustrations showing the effects of the earthquake. Views of the crack in many different localities showed it stretching clear across the scene, in many places clear and distinct, in others only traceable by an expert. Its course was indicated usually by a slight elevated ridge of earth. Where it intersected fences, they were broken, and the fence on one side of the crack was carried in some cases fourteen to sixteen feet away from that on the opposite side.

Where trees lay in the path of dislocation, they were shown in some cases fallen because of the loosening of the roots, in others split in two.

Bridges were removed from their piers. One picture showed a bridge the piers of which had been severed horizontally, and the upper portion moved a short distance, but still resting dislocated on the lower portion.

The pushing aside and breaking of the water pipes at their joints, as they lay in a direction parallel with the earthquake crack, affected the pipes as they crossed the line of fracture in such a way that one portion of them were squeezed together and telescoped, while another portion of them were drawn apart, giving the line a zigzag appearance, resulting in such utter destruction as to render repair impossible, and thus to deprive San Francisco of its water supply and thereby render the fight with fire hopeless at the critical period.

The effect on buildings was very different in different locations and with different structures, ranging from entire demolition to slight dislocation. Several views were given of buildings on the line of fracture which had been partly split, and the portions on opposite sides of the crack moved away from each other. A stable had been moved a few feet leaving a pile of manure standing beside it several feet distant from the window out of which it had been thrown, while the discolored wall against which it had rested was still seen underneath the window from which it had been thrown out. In a brick building the entire upper story had been shaken down and out from under the roof, the latter having settled evenly upon the story below.

Lantern views illustrated many instances of the great damage done at Dr. Branner's own university—the Leland Stanford, Jr. It may be worth mentioning, though the speaker did not refer to it, that the striking difference in the effect of the earthquake on this university and on the University of California was due to the fact that the latter was founded on a rocky locality, and the former on softer ground. The earthquake commission appointed by the Governor of California in their preliminary report state that waves transmitted through rock were more rapid but less dangerous than those through less solid formations.

The reported engulfing of a herd of cattle was explained as a misapprehension. The cattle were involved in a landslide caused by the earthquake, and were all extricated.

The lecturer concluded by stating that earthquakes were natural phenomena; and if it were not for the resulting damage, he would like to see more of them in order to study them. Despite the earthquake, he regarded California as an ideal place of residence.

## THE NEW JAPANESE BATTLESHIPS "KATORI" AND "KISHIMA."

BY J. B. VAN BRUSSEL.

The new first-class Japanese battleship which terminated her official trials on June 1 last, and is now steaming in company with her sister ship, the "Kishima," represents the most advanced ideas of Japanese naval authorities and of her builders, Messrs. Vickers, Sons & Maxim, Ltd. The armament and armor surpass those of any ship now in commission.

The main dimensions of the vessels are the following: Length between perpendiculars, 420 feet; length over all, 455 feet 9 inches; breadth, 78 feet; depth to upper deck, 44 feet; draft, 27 feet; displacement in tons, 15,950.

The propelling machinery of each ship consists of two sets of four-cylinder triple-expansion engines balanced on the Yarrow-Schlick-Tweedy system, each set having one high, one intermediate, and two low-pressure cylinders. The diameters of the cylinders are respectively 35½ inches, 56 inches, and 63 inches for each of the low-pressure cylinders, with a stroke of 48 inches. The steam pressure at the boilers is 230 pounds per square inch, and at the engines 200 pounds per square inch. The engines are designed to turn the propellers inward when going ahead, so that the starting platform is in the center of the ship. Wrought-steel columns form the supports of the cylinders, which are independent castings, and the back supports are of the ordinary cast-iron "A" framing, with ample slipper-guide surface. The condensers, four in number, are placed in the wings of the ship. The total cooling surface is 17,000 square feet. Each crank-shaft is in two interchangeable pieces, and the propeller shaft is 18 inches in diameter, with a 10-inch hole, while the propellers have four blades, the diameter being 17 feet 3 inches.

The boilers are of the latest Niclausse type, twenty in number, disposed in 3 separate boiler rooms, 5 with 16 sections, and 15 with 15 sections, each section consisting of 24 tubes. The total heating surface is 44,000 square feet, and the total grate area 1,334 square feet. There are two funnels, the forward one being 12 feet 9 inches in diameter over the casings, and the after one 12 feet 9 inches by 8 feet 1 inch over the casings, the height from the fire-grate being 90 feet.

The armament consists of four 12-inch, four 10-inch, twelve 6-inch, twelve 12-pounders, three 3-pounders, six Maxim rifle-caliber guns, five submerged torpedo tubes.

The four 12-inch 45-caliber breech-loading guns are mounted in pairs in barbettes, two forward and two aft, behind 10-inch armor. These guns have a total length of 556.5 inches, a length of bore of 540 inches, and a diameter of bore of 12 inches. The total weight of these guns, including the breech mechanism, is of 57 tons 9 hundredweight, 2 quarters, and the weight of each projectile 850 pounds. The muzzle velocity is 2,860 feet per second, the muzzle energy 48,210 foot-tons, and the energy at four miles range is 18,950 foot-tons. The 12-inch guns are wire-wound. Their breech mechanism is of a new and improved type, and is arranged to be operated either by hydraulic gear or by hand. The hydraulic gear consists of an hydraulic ram mounted in suitable brackets on the end frame above the breech mechanism. The ram gears, by means of a rack, with pinion and clutch gear on the top of the hinge-bolt. This clutch is thrown out of action at any time by a hand-wheel mounted at the bottom end of the carrier hinge-bolt, and is so arranged that it is impossible to have both gears in operation at the same time. The hand gear for operating the mechanism consists of a hand-wheel, with worm and worm-wheel gear, mounted in a bracket at the lower end of the hinge-bolt, and secured to the frame of the gun. The worm and wheel gear are arranged so that 17 turns are required to operate the breech mechanism; 12.2 turns to unlock the breech; and 4.8 turns to swing the mechanism out to the "fully open" position. One of the chief features of the new mechanism consists in the application of a "couple" for rotating the breech-screw. In breech mechanisms as at present generally constructed, the breech-screw is rotated by a turning moment, which has been found to set up considerable friction, owing to the tendency of such moment to occasion axial displacement of the breech-screw. By applying a "couple" for this purpose this difficulty is obviated, so that the whole of the available turning force applied to the breech-screw is utilized in seating the obturator.

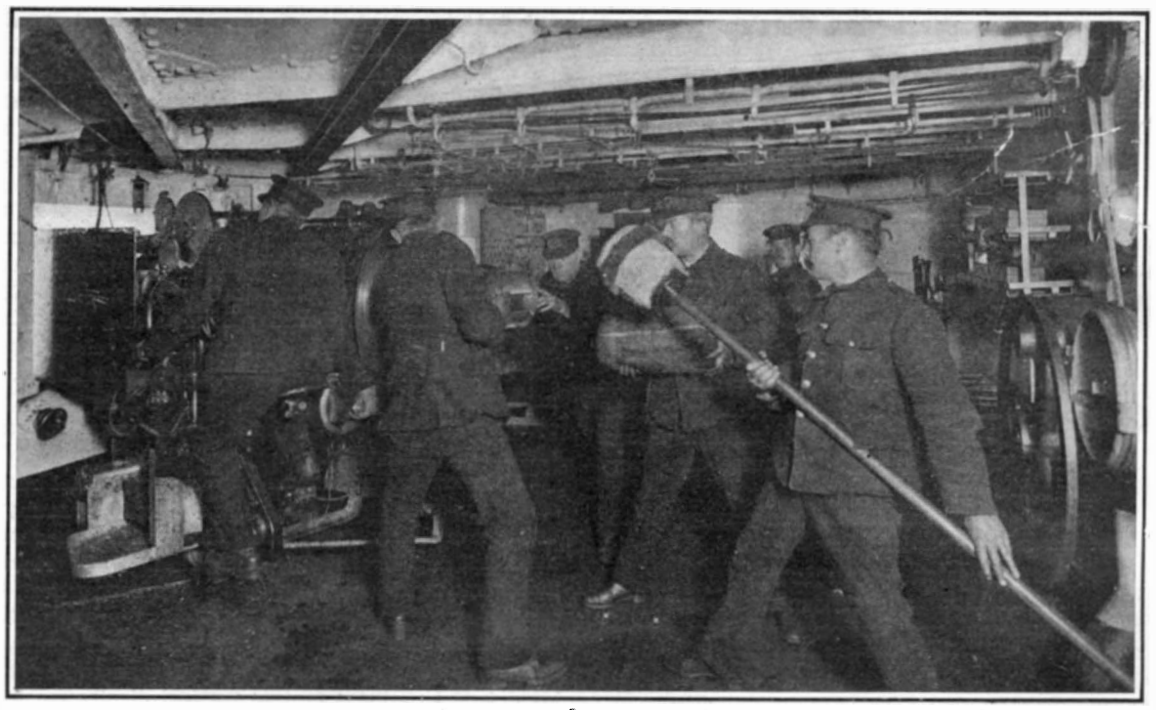
The mountings for the 12-inch guns are operated hydraulically, but most of the operations can also be performed electrically. Protection is afforded to the gun crew, and to the upper parts of the mountings, by a heavily armored shield, securely attached to the upper surface of the turntable.

No less interesting are the ammunition hoist and loading devices. The projectile is lifted from the bins by an overhead carrier. Two jaws on the carrier drop on each side of the projectile, and the pulling forward of a handle operates toggle levers, which close the jaws around the shot. The carrier is then raised by

its hydraulic press, and is traversed to the base of the trunk on joist rails by means of an hydraulic ram working through cables and pulleys. The shot is deposited on a receiver, and is there held in position by stops on the top, which is inclined so that when the stops are lowered the projectile rolls on to a corresponding receiver or bogie, which can follow the rotation of the ammunition trunk by the turning of pinions engaging in the toothed rack round the base of the trunk. The traversing pinion within this bogie is operated at considerable speed by a hand-wheel and worm-gear. The introduction of this intermediate bogie serves to bring the shot to the base of the hoist, when the latter is revolving with the guns; the fixed receiver at the same time enables additional projectiles to travel on their way to the gun. Thus there may be one shot on the carrier, another on the fixed receiver, a third in the bogie, a fourth in the hoist to the shell chamber, where the ammunition is transferred to another hoist communicating with the charging platform, so that there may be a fifth in the upper hoist and a sixth in the gun. The increase in the number of shots between the shot-bins and the gun chamber renders it possible to maintain a greater rapidity of fire for a short period, notwithstanding the great weight of projectile and powder charge.

The charge is loaded up in quarters, within silk bags, on a level above the shell chamber, and the hoist for the charge, while within the same trunk, is independent of that for the projectiles.

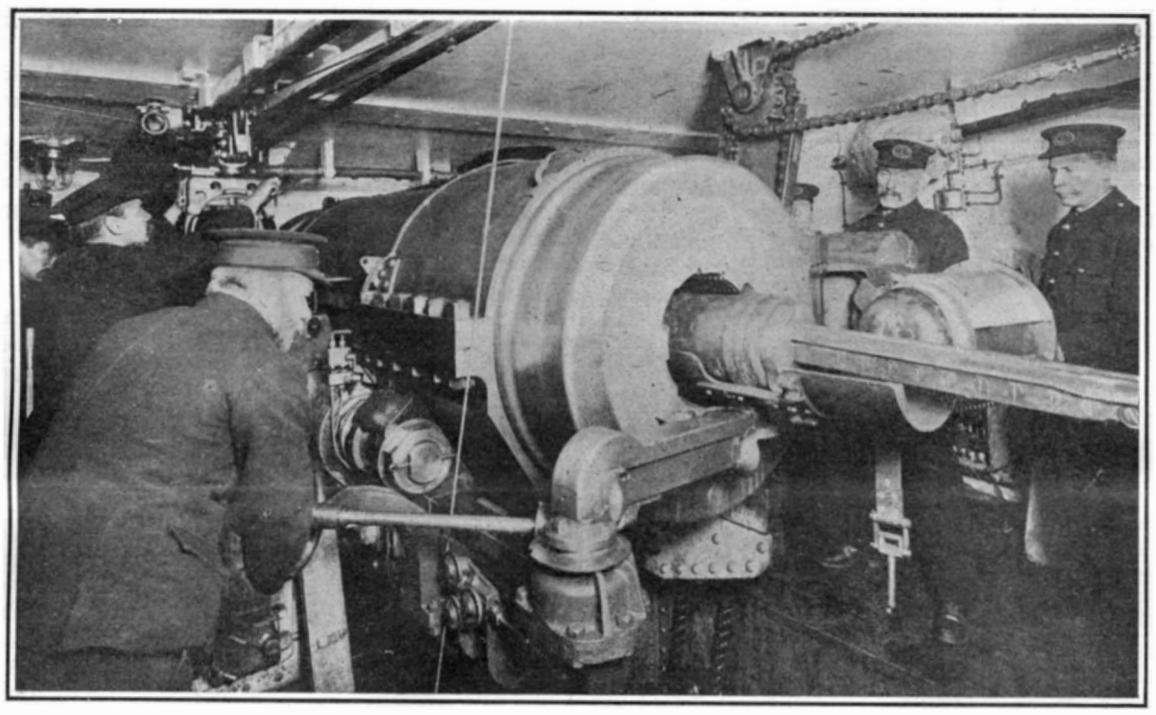
In the working chamber both projectiles and powder charges are arranged to come into position at the top of their respective hoists in this working chamber for direct hydraulically-operated transference to the gun-



Loading 6-inch Rapid-Fire Gun Within Casemate.

elevation or depression, and even with the guns moving during training operations.

In the 12-inch turret three sighting positions are provided, one center position between the guns being fitted with two sights, with a single sight at each side position.



Loading a 10-inch Gun in Barbette, Showing the Loading-tray.

loading cages, which rise from this level to the loading trays behind each gun. The two gun-loading hoist-cages which serve the guns are arranged to work on curved rails passing from the shell-room up into the turntable at the rear of the guns, the arrangements being such that the guns can be loaded at any angle of

The four 10-inch 45-caliber breech-loading guns are mounted single at each corner of the citadel in barbettes, with armor 6 inches thick. The breech mechanism for these guns is very similar in principle to that of the 12-inch gun, except that it is operated by a hand-lever, pivoted so as to swing in a horizontal plane. Furthermore, whereas the 12-inch weapons are run out by hydraulic power to the firing position, the mounting of the 10-inch guns includes recuperative springs, which effect the return to that position.

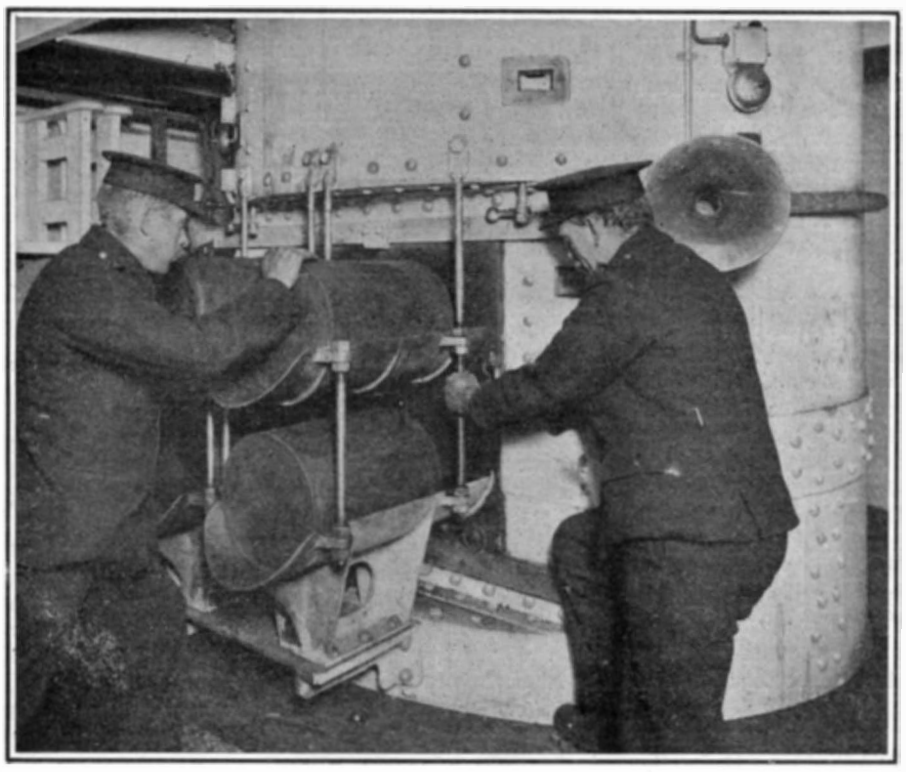
The twelve 6-inch 45-caliber breech-loading guns are carried on pedestal mountings, ten placed on the main deck and two on the upper deck. A special feature of the mountings of these guns is the sighting gear, which is telescopic and arranged for use with a separate sight setter, so that the gun-layer is enabled to concentrate his attention on the object.

The main armor-belt of each ship has a depth of 7 feet 9 inches, of which 5 feet 3 inches is below the water-line, and extends from end to end of the vessel, its thickness being 9 inches for a length of 240 feet amidships, reduced gradually to 4 inches at the stem. Armor bulkheads 9 inches thick are carried across the ship at the forward and after ends of the 9-inch belt, extending in depth from the lower to the middle armored decks.

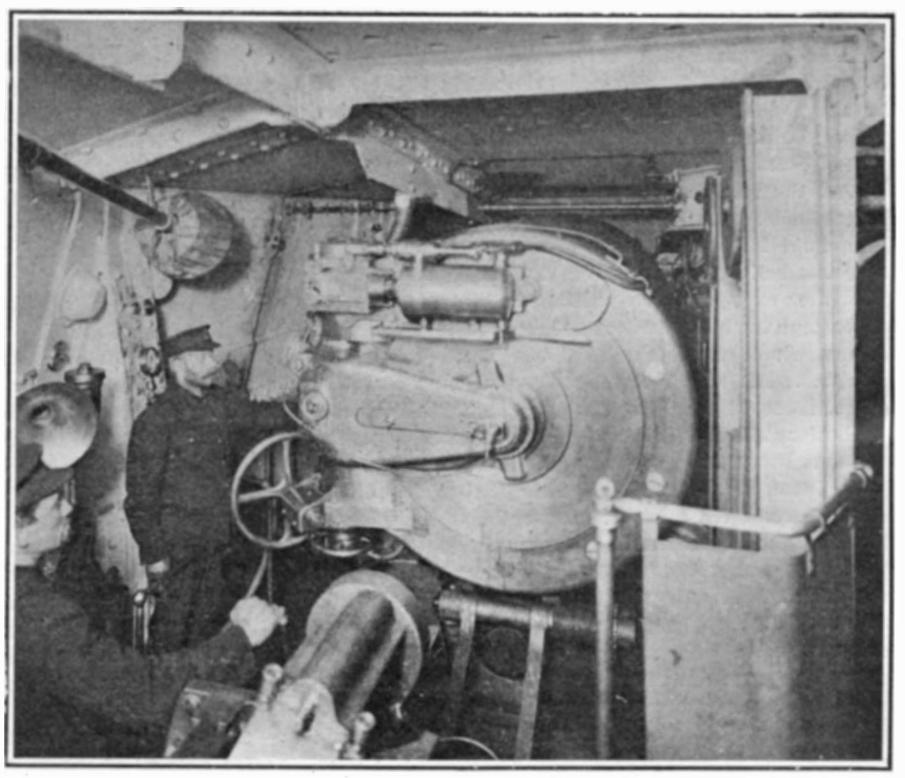
The armor protecting the citadel containing the 6-inch guns is 6 inches thick. The armor on the barbettes inclosing the 12-inch guns is 10 inches in thickness generally, but reduced to 5½ inches thick where protected by the belt and battery armor.

The 10-inch guns are mounted in barbettes, the upper portion of the armor being 6 inches thick and the lower portion 2 inches. The armor of the conning tower is 9 inches thick, and the observer tower 5 inches thick, the tubes for communication from these being 8 inches and 4 inches thick respectively. As in recent ships of the British navy, entrance to the conning tower is from the wheel-house through a hatchway in the armored roof.

The vessel, which will have a total complement of 980 officers and men, gave during the official trials a mean speed of 20.22 knots, with the engines developing their full power, and making about 130 revolutions per minute. As to the coal consumption, when the speed was 17.8 knots, it worked out at 1.6 pound per indicated horse-power.



Placing Charge on the Ammunition Hoist for the 12-inch Guns.



Interior of 12-inch Gun Barbette, Showing Hydraulic Gear with Loaded Gun.

THE NEW JAPANESE BATTLESHIPS "KATORI" AND "KISHIMA."

## NEW SOURCES OF GOLD.

BY WALDON FAWCETT.

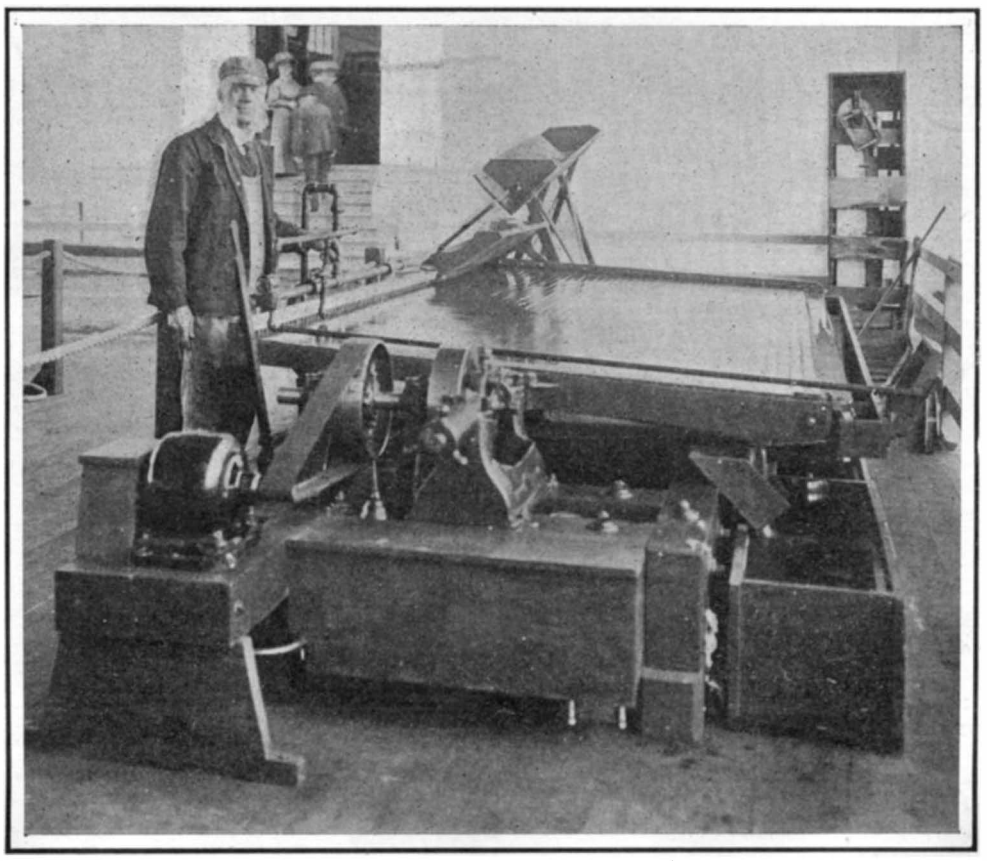
At an experiment station established at Chapel Hill, N. C., the Division of Mines of the United States Geological Survey is now seeking to devise a means of rendering commercially available the low-grade gold deposits of the mid-Atlantic and Southern States. Should the present effort prove successful, a method will be developed for deriving not only gold but other valuable minerals from a sediment that has heretofore been regarded as worthless. The primary purpose of the government scientists in their present tests is to ascertain the types of machinery best adapted for extracting the mineral wealth from deposits which have heretofore been regarded as of too low a grade to be worked profitably. The work was first taken up on the Pacific coast more than a year ago, and the results which attended the operations at the experiment station, or "concentrating pavilion," as it was termed, conducted by the Geological Survey at the Portland Exposition, were so gratifying as to induce the officials to seek similar possibilities on the Atlantic coast.

The investigation in the West last year was inaugurated because the exigencies of the Russo-Japanese war demonstrated how desirable it is for the United States to have its own source of platinum supply, instead of being dependent solely upon foreign mines; but in the end it was found that not only platinum, but gold and other valuable substances could be derived from what is generally referred to as "black sand." For the benefit of the lay reader, it may be explained that the term black sand is applied to the heavy sediment which is likely to be found wherever water has had an opportunity to work on the soil. There are many acres of this sand on the sea beaches, but vast deposits of it are also found at inland points, and especially in localities where hydraulic mining has been carried on. In most instances the placer miners were fully aware that some mineral wealth remained in the material which they discarded, but they had not the equipment to render its recovery profitable. It is such an economic process that is now being sought by the Division of Mines. In the experiments thus far conducted, the discovery was frequently made that a given deposit did not contain a sufficient quantity of any one mineral to justify its manipulation for any single product, but that if all the valuable contents were saved, the aggregate returns would be highly profitable. On the other hand, the officials of the Geological Survey have discovered sand deposits, notably those in Humboldt County, California, which show a good assay value in gold and platinum.

Apparatus showing a wide range in design and function has been tested by the government officials in connection with the black sand investigation, but the most important class of mechanical helpers is made up of the concentrators or concentrating machines. The concentrator derives its name from the fact that by a peculiar, continuous movement it concentrates the mineral particles rescued from the sand, and brings them to a common point of discharge. The concentrators, however, form but one link in the chain of appliances that figure in the treatment of the samples of black sand furnished to the government officials for investigation. These samples, it may be added, are supplied in consignments that range in quantity all the way from a few hundred pounds to carloads. The first step in the testing process as conducted at the experiment station is the placing of the given consignment of sand in a "feeder," from which it is elevated by a belt conveyer and delivered to a screen. Next the material passes to a revolving mixing distributer, from which it is piped to the different concentrators. The plant includes four or five concentrating machines, which are in simultaneous operation. The utilization of the mixing distributer insures an even quality of pulp for all the concentrators.

After the material has passed over one or another of the concentrating tables it is placed in a drying furnace, where all the moisture is expelled. After the pulp is thoroughly dried it is passed through a magnetic separator, where the magnetic elements are extracted. The magnetic machine effects the separation of magnetite, chromite, garnet, monozite, and quartz, all of which are found in the black sand, in addition to the mineral substances already mentioned. The experiments made by the Geological Survey in the West seem to indicate that there is enough magnetite in the black sands of the Pacific coast to supply all the iron and steel required on our western seaboard. Zircon, which is worth $200 per ton, shows in much of the sand, and much of the material that has been submitted for testing purposes has been found to run high in monazite, which is used in the manufacture of gaslight mantels and has practical value.

The concentrators, which, working rapidly and cheaply, are instrumental in deriving wealth from the heretofore worthless black sand, might as a class be popularly described as quivering tables over which pour perpetually streams of water. In the case of a representative concentrating machine, the shaking table is constructed of wood and steel, upon the surface of which a corrugated, vulcanized rubber sheet molded in one piece is firmly fastened. There are about eight corrugations or grooves to the inch, each about one-eighth of an inch in depth. Upon the surface of this grooved rubber, longitudinal riffles of solid rubber are molded, terminating at a point about three-quarters of the length from the feed end of the table. When the gold-bearing sand is placed upon one of these concentrating tables, the rush of water pouring over the surface carries off the mud, clay, and other worthless materials, whereas the particles of minerals being heavier sink to the bottom, and are stopped in the riffles. The constant trembling of the table constitutes the means of concentrating these mineral particles and bringing them to a common point of discharge.

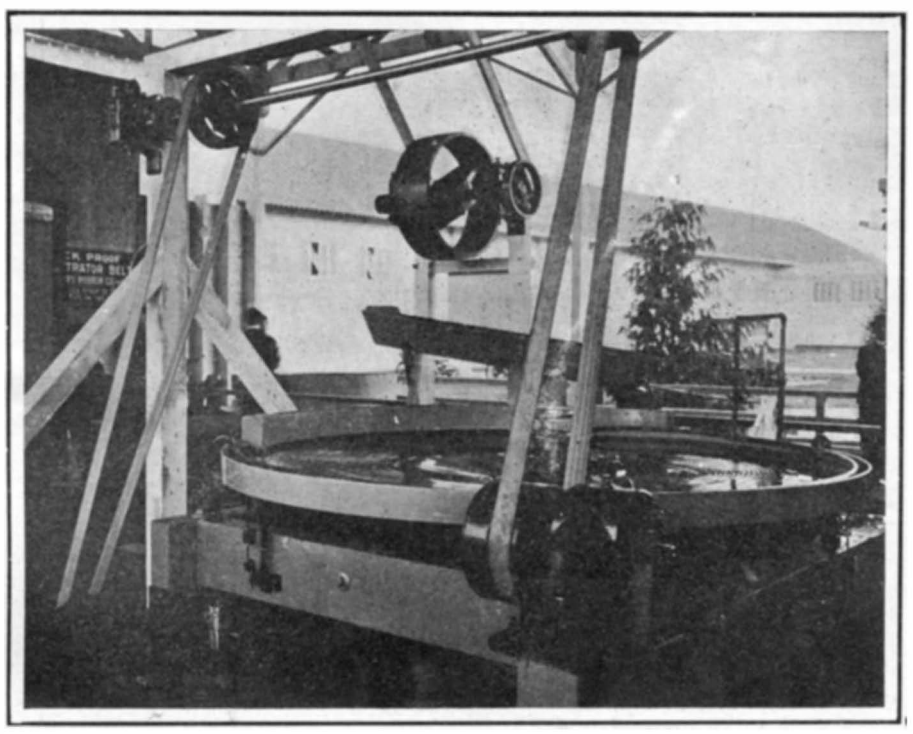


Motor-Driven Concentrating Machine for Handling Low-Grade Gold Deposits.

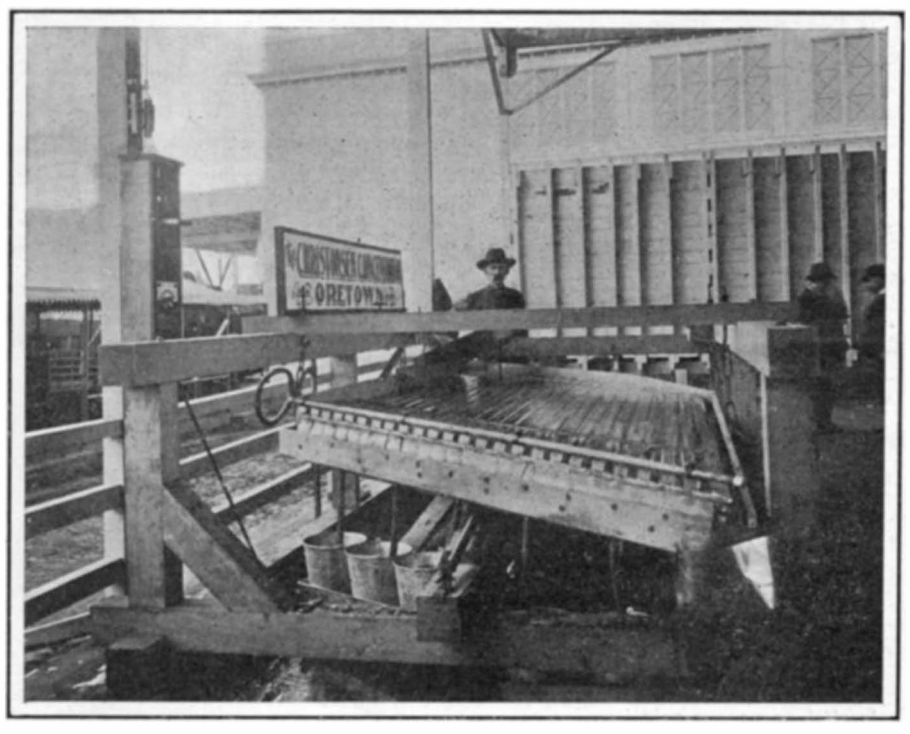
Further following the process of operation of this typical concentrator, it may be noted that the top or working surface of the concentrating table has an inclination downward and across the table transversely, or from side to side, and inasmuch as the material to be treated is introduced at the higher side near one end, a movement of this material is produced diagonally over the working surface, under the combined action and influence of the flow of water and the vibratory motion and inclination of the table. The "tailings" or discarded materials are discharged over the lower side of the table, while the concentrates or gleaned minerals are discharged at the head of the table.

One type of concentrator which is being tested by the government officials, and which differs from the familiar oblong pattern, has the table in the form of a circular pan with the bottom sloping toward the center. Its entire surface is covered with brown linoleum of a special make, and on this is placed a system composed of fifty-six tapering riffles, arranged spirally and radiating from the direction of the center outwardly. The riffles in the case of this machine are composition brass.

The capacities of the various concentrating tables vary considerably, being dependent in no slight degree upon the character of the material under treatment. In a general way, it may be said that the minimum capacity of the average machine is about ten tons per twenty-four hours, while the maximum capacity is



Circular Type of Concentrator for Refining Black Sand.



Concentrator in Use for Extracting Gold from Black Sand.

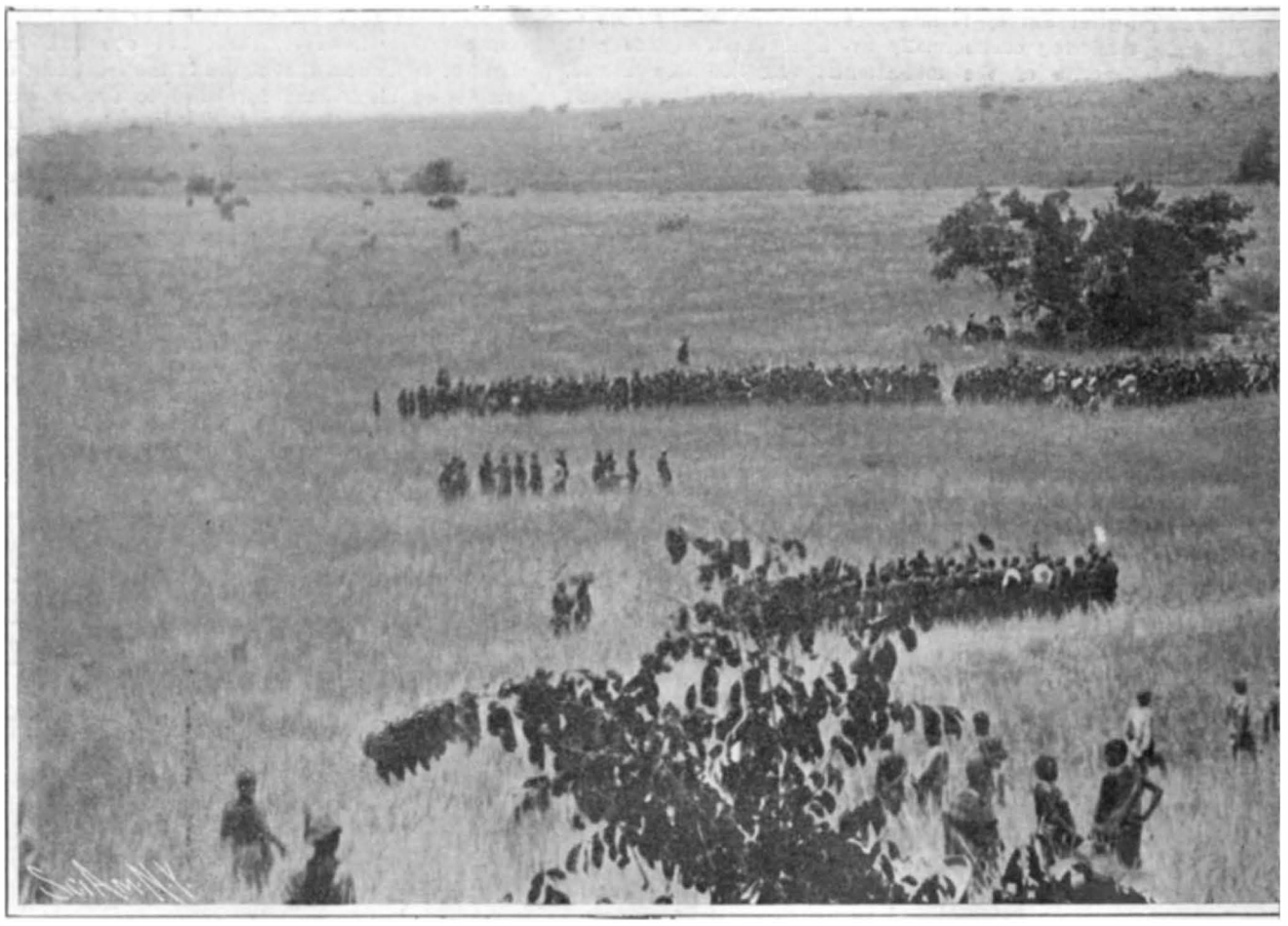
from thirty to forty tons, and there have been instances in which a concentrating table has satisfactorily handled as much as fifty tons in twenty-four hours. The amount of water required for the operation of a machine ranges from five to twenty gallons per minute. The concentrators utilized by the government in its present experiments are operated by individual electric motors of from one-half to two horse-power each.

### THE FIGHTING TRIBES OF SOUTHERN AFRICA.

Scattered through her vast territories, Great Britain numbers among the subjugated races hundreds of peoples which even to-day are savage, turbulent, and restless, ever seeking opportunities to rise and throw off the yoke with which the white man has burdened them. Rare, indeed, is the time that some English force is not somewhere engaged in a repressive or punitive expedition, or in restoring order in rebellious territories. For a number of years past the blacks of South Africa have been comparatively quiescent; the white troopers and native rangers in the pay of the government have done their work thoroughly. Particularly is this true in the native states near the earlier white settlements, or of those tribes which disputed the right of way with the Boers. England's policy with regard to the natives, and not of South Africa alone, has often been one of the crassest ignorance and misgovernment, and one moreover which frequently resulted in those terrible uprisings and colonial wars which have blotted the history of many of her fairest dependencies. And while the white man has, of course, been victorious in the end, the cost has sometimes staggered humanity. The policy of the British government in South Africa to-day bids fair to arouse the still savage black population to united revolt, and reports from disaffected districts indicate that the disturbances are of greater extent than is generally realized.

The act which has been the ultimate cause of the present rebellion of the negroes is known as the "Glen Grey Act" of Cape Colony, and its real author was that master mind of South Africa, the late Cecil Rhodes. This law, which to-day exists also in Natal, Orange River Colony, and the Transvaal, provides that every native must pay a yearly head tax, and in default be imprisoned for a certain period, or work off the tax and attendant fine in the employ of some white man. The last clause explains the true significance of the law and the reason for its enactment—the labor problem. While the earlier differences between the natives and the settlers were due to territorial and governmental disputes, for the last twenty years these questions have fallen into the background before the problem of native labor. The year 1886 saw the beginning of the great mining industries with the discovery of gold on the Witwatersrand—industries which, of necessity, require the employment of many thousands of laborers. Because of the small number of the whites, and for climatic reasons, the laborers were to be found only in the ranks of the native blacks. Now, the native is constitutionally and ethnologically averse to protracted labor. He will work in fits and starts at that period of the year which is climatically unsuited to his tentative agricultural pursuits, or his care-free loafing—in other words, the winter. Even the head-tax scheme, however, failed substantially to improve the labor market, and as the subsequent importation of coolie workers into South Africa has not been very successful, the labor problem is still no nearer solution.

One thing is certain, the natives resist the imposition of the tax in every possible manner—by trickery, by evasion, and finally by force. The present uprising under the chief Bambata is directly due to the head tax; it followed the killing of two English collectors by Zulus, with the subsequent execution by the government of twelve natives implicated in the murders. Whether there is sufficient cohesion between the various tribes to make possible a general rebellion is prob-



Kafirs Assemb

A Zulu War Party Ready for the Trail.

Kafirs Traversing a Trail T

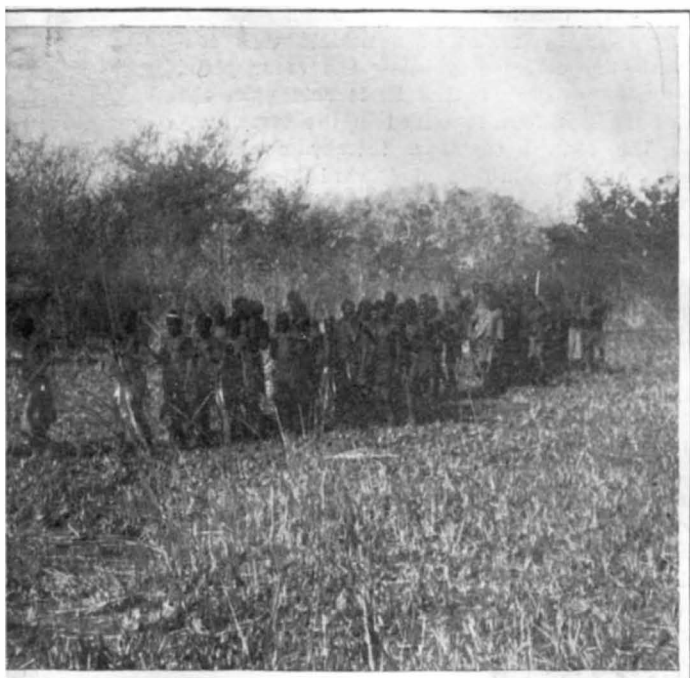
A Great Kafir War Dan

lematical, but the revolt is unquestionably spreading, and already one British force has suffered a reverse. The blacks of South Africa, the Kafirs, must be considered among the sturdiest of savage fighters; especially is this true of such tribes as the Zulus and Matabele. Whether their fighting ability is still such as seriously to menace the white man's superiority, even temporarily, remains to be seen.

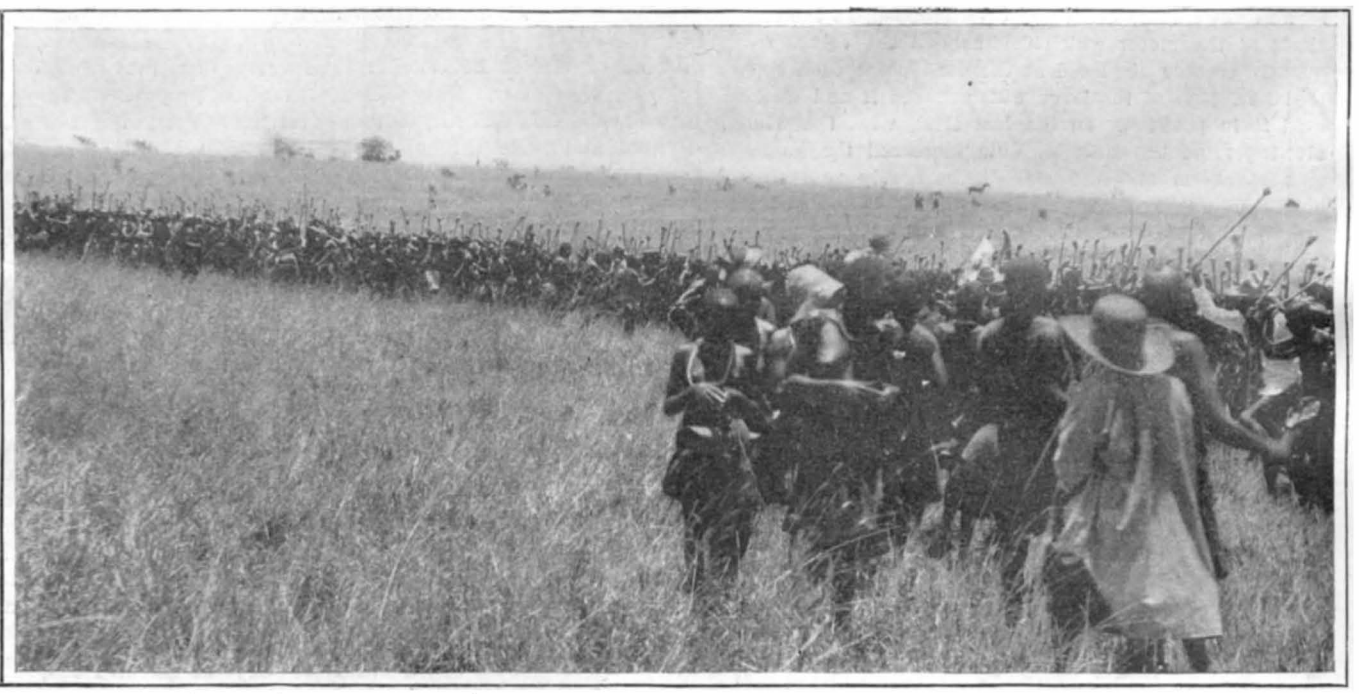
ling for the War Dance.

The South African native, exclusive of the Hottentot or Bushman, must be counted among the highest of the blacks. Certain of his characteristics are admirable; he is brave to a fault, and a most consistent enemy, while capable of fidelity and gratitude. Where contact with the white race has not corrupted him, he is fairly honest, though, it must be admitted, lazy and improvident. By nature he is a savage, and as such he wages savage war, often with a brutality and bloodthirstiness which seems incomprehensible to us—who prefer to kill at half a mile with a leaden pellet, rather than with a three-foot spear blade at half a yard. Dispossessed of his lands by force, ever driven backward by British, Boer, or Afrikander, the prey of a civilization which he can neither understand nor acquire, it is little wonder that the black has at times resisted primitively, fiercely, and desperately. His is the story of the Indian, of the Polynesian, of the savage the world over, a pitiful story that is as unchangeable as history itself, and that can have but one ending, the absolute supremacy of the white race. Whether or not this means the destruction, the absorption, or the independence of the native is a question for future generations to solve.

The Kafirs are ethnologically cattle breeders, though their agriculture includes the raising of various vegetables and fruits. They eat meat only when fighting, and the cattle are used largely as a medium of exchange. Their houses are cone-shaped and are grouped in kraals. The male is essentially a warrior; the woman, the farmer and the general drudge. The Kafir's life-long feuds with his enemies, native and white, have developed in him mental and physical qualities far above those of the true negro. He is tall, slim, and muscular and capable of great physical exertion. His native weapons are the knob-kerry, or striking and throwing club, and assegais, or spears for hurling or thrusting; he protects himself with a great



hrough the South African Bush.



A Nearer View of the War Dance.

on the South African Veldt.

ES OF SOUTHERN AFRICA.

decorated shield of toughened ox-hide. The original religious beliefs of the Kafirs are on a much higher plane than those of most other African tribes; the type of religion was an advanced grade of ancestor worship. The government of the tribes is an absolute chieftaincy, with an hereditary sovereign or *Inkose*.

The great Kafir tribes, which doubtless drove out the original Hottentot-Bushmen, belong to the Bantu family, inhabiting the eastern and coastal regions of the southeast part of the continent. The name Kafir is generic, and applies to almost all the blacks inhabiting South Africa, so called, and includes to-day the Zulus, Matabeles, Basutos, Bechuanas, Swazies, Pondoes, and Fingoes, with several lesser tribes. At the period when the early settler began to penetrate from the coast, the Kafirs included over a thousand distinct tribes, but continued wars with one another and with the whites have so materially reduced these tribes by extermination and consolidation, that but a handful remains to-day. The first Kafir war with the settlers began about 1785, arising from a boundary dispute between the Zulus and the Dutch. Since that time the clashes with the white settlers have been numerous, sometimes mere spontaneous and scattered uprisings, and at other times bloody and protracted wars, such as those with the Zulus and Matabele. Nor have the white men been always undefeated, as evidenced by the terrible battle of Isandula, where a British column was overwhelmed and destroyed by 20,000 of the splendidly-trained warriors of Cetywayo, the greatest of the Zulu kings. The Zulus are easily the best of the Kafir races, and have always offered the sturdiest resistance to the whites. Their intelligence is well above

the average; they are fairly moral, and in the native state temperate in all things. The desperate courage and fighting ability of the Zulus is historic throughout South Africa.

Notwithstanding the reduction in numbers which the Kafirs have suffered during the last generations, they are still numerically strong enough seriously to menace the white race. It is estimated that the natives of Cape Colony number about 1,350,000; of Basutoland, 300,000; Natal, 400,000; Zululand, 150,000; Amatongaland, 25,000; Bechuanaland, 50,000; Orange River Colony, 125,000; Transvaal and Swazieland, 700,000; Rhodesia, 1,500,000; and Nyassaland and neighboring territories, 1,100,000; while the total whites in the colonies number but 1,250,000. The safety of the settlers doubtless lies therein that the Kafirs are disintegrated and lack tribal cohesion. Were it not for this, a concentrated uprising might sweep the entire white population into the sea, necessitating the final crushing of the blacks by superior weight and armament, and with the subsequent recommencement of the entire work of colonization. It is to be hoped that the present sporadic uprising will be suppressed at once, either by overwhelming force, or, preferably, by conciliatory measures; for a savage native war, aside from the horrible barbarities which usually are incident to it, would seriously menace the present increasing prosperity and development of the South African colonies.

### Results of an Experiment with the Vuia Aeroplane.

The Vuia aeroplane, which was illustrated in our issue of March 24 last, was subsequently experimented with by its inventor at Montesson, in France, and the results were more or less satisfactory. In describing the action of the machine, M. Vuia says that one of the first things he noticed when it was under way was that each time the forward springs of the running gear expanded owing to the lift, the speed increased and he did not feel the inequalities of the ground, notwithstanding the bad condition of the road. The propeller slowed down quite often and even stopped, as the cam shaft of the motor which commanded the valves frequently became displaced at the dead point each time that he let go of the lever which moved it and which held it in position. In the last trial, with the wind blowing from the side, M. Vuia increased the admission of steam and the machine suddenly rose to a height of about two feet. Unfortunately, as soon as the apparatus left the ground, the propeller slowed down and the machine, driven by the side wind, after several balancings, landed on the ground so gently that he was not able to feel the least shock or to know the exact moment when it touched the earth. After it landed, the machine was overturned by the wind, and the propeller and three of the sustaining tubes were damaged. The distance traveled in the air was about forty feet. The inventor estimates that the speed attained by the machine was about thirty miles an hour, while he states that the power expended was only about a third of what he had at his disposal. The aeroplane was inclined at an angle of 10 degrees.

As the result of these experiments M. Vuia has reached the following conclusions:

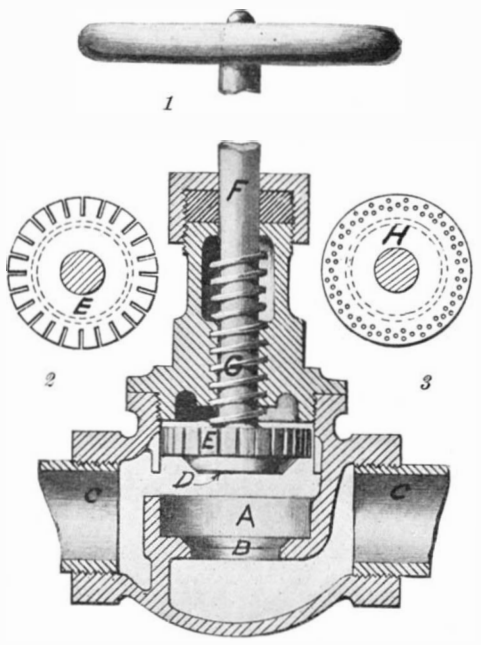
1. As soon as the machine acquires a certain speed the lifting of the wings is sufficient to counteract any inequalities in the ground.
2. As soon as the propeller stopped the machine did not run more than 60 to 90 feet on the ground, while formerly, when not furnished with the wings, it ran fully 450 feet after stopping the propeller. This demonstrates that the resistance opposed by the wings annuls very quickly the momentum of the machine.
3. The resistances of the frame and of the chassis of a machine of this type, at the speed necessary for soaring, are so small as to be negligible.
4. The power necessary to raise an aeroplane is much less than that claimed by experimenters.
5. That an aeroplane is not a dangerous machine if simple means are employed for launching it.
6. An aeroplane mounted on pneumatic-tired wheels can be started easily, even upon bad roads.

The Vuia aeroplane consists of a pair of wings mounted upon a framework of steel tubing, which in turn is supported upon four pneumatic-tired wire wheels. The weight of the entire apparatus, with operator, is 803 pounds. The wings are 7.87 feet wide from front to back, with a total spread of 28½ feet. A 7¼-foot propeller having a 7¾-foot pitch is placed beneath the wings in front and is mounted directly on the shaft of the 25-horse-power carbonic-acid gas motor.

The services which automobiles can render in military operations are becoming more and more appreciated in the Austrian army. A series of practical maneuvers which were exclusively reserved for automobiles and motor-cycles took place not long since over the route between Prague and Reichenberg. In these maneuvers were represented the Automobile Club of North Bohemia, the motor-cyclists of Reichenberg, and the chauffeurs of Prague and the vicinity. The idea followed in the maneuvers was to take possession of the bridges of the Elba which were menaced by the enemy's cavalry, while the cavalry which were charged to defend them would not have time to arrive on the spot. These maneuvers presented the greatest interest and are another proof of the great services which the cars and motor-cycles will render in time of war.

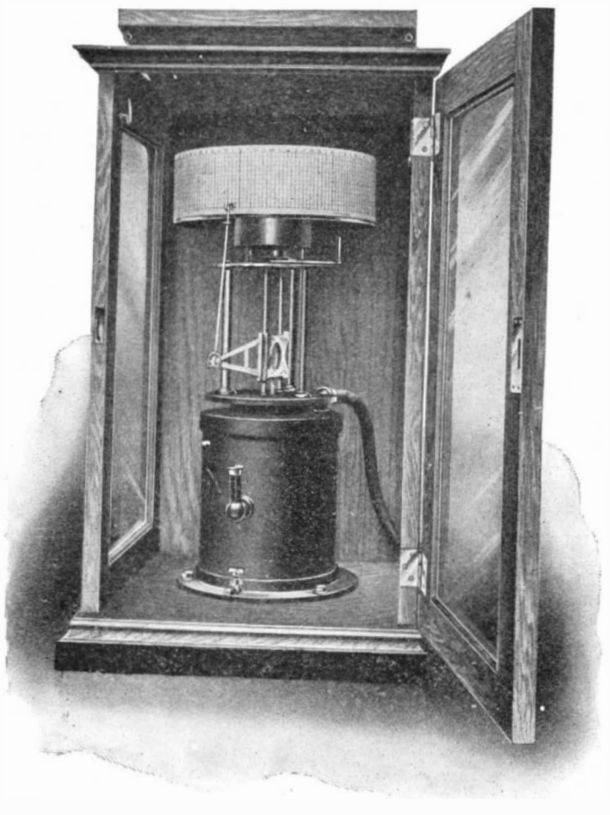
### AN IMPROVED VALVE.

The valve illustrated in the accompanying engraving has been designed with a view to preventing scale or foreign substances being caught on the valve seat as the valve is being closed. As is well known, this is a common source of trouble with valves, for the obstruction either prevents the valve from entirely




AN IMPROVED VALVE

closing, or else is imbedded in the valve seat, thus injuring the latter. The present invention proposes to overcome this difficulty without restricting the flow of fluid and scale through the valve, except at the time of closure. Under normal conditions, when the valve is open, both fluid and scale may pass through as in other valves, but while the valve is being closed the fluid is strained, though sufficient fluid is permitted to pass through the valve to wash the seat clear of all obstructions. Our illustration shows a valve casing of the globe type, the seat being shown at *A B*, and the service pipes entering at *C* and *C*. The valve seat comprises a recess, *A*, with a vertical wall, and the seat proper, *B*, which has a tapered wall. The valve comprises a tapered portion, *D*, adapted to fit snugly in the seat, *B*, and over this is a strainer disk, *E*, which is adapted to be seated in the recess, *A*.



AUTOMATIC DEPRESSION RECORDER FOR THE SCIENTIFIC CONTROL OF MINE VENTILATION.

This strainer disk, as shown in one of the detail views, is formed with radial slots cut in its periphery. The valve is carried on a stem, *F*, formed with a thread, *G*, so that it may be fed in the usual manner toward and from the seat. In practice, when the valve is being closed the strainer disk, *E*, will first enter the recess, *A*, and thus prevent a flow of scale or other obstructions with the fluid through the valve. However, a quantity of fluid will flow through the slots and clear the seats, *A* and *B*, of obstruction, so that when the valve is lowered to its fullest extent, there will be nothing to interfere with a tight closure of the disk, *E*, with its seat, *A*, or the plug, *D*, with its seat, *B*. As a modification of this construction, a strainer disk of the type shown in Fig. 3 may be used. This disk, *H'*, is formed with a series of perforations instead of radial slots, thereby producing a more thorough straining of the fluid. A patent on this improved valve has recently been procured by Mr. Charles E. Simpson, of 808 Gallia Street, Portsmouth, Ohio.

### AN AUTOMATIC DEPRESSION RECORDER FOR THE SCIENTIFIC CONTROL OF VENTILATION IN MINES.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The existing methods of ascertaining the state of the ventilation of a mine by means of a water gage on the record of the speed of the fans is unsatisfactory, because of the fluctuating conditions which always prevail and the absence of any means of determining whether the ventilation remains constant. Consequently, these systems by no means afford an adequate provision against the very serious dangers of insufficient ventilation.

With the new recorder illustrated, a continuous record of the volume of air actually drawn into the mines by means of the fans, as inferred from the depression in the shafts, is obtained, and the engineer can at all times accurately ascertain whether or not ventilation is efficient. The construction of the instrument is based upon the hydrostatic principle.

The recorder comprises a cylinder in which works a perfectly-balanced float, of great sensitiveness, moving in an inner receptacle. Instead of using water, which occasions constant trouble through evaporation and condensation, whereby the volume is continuously varying, glycerine is employed, so that recharging and adjustment of the apparatus are obviated. The instrument is attached directly to the ventilating shaft by means of a flexible tube connected with the device just below the cover plate. The depression existing in the shaft acts upon the surface of the glycerine contained in the vessel surrounding the central chamber, thereby causing a movement either upward or downward of the glycerine within the inner cylinder containing the float.

Attached to the float is a beam or lever carrying the recording pen, which inscribes the reading upon a calibrated cylindrical chart attached to the top of the instrument. The rod which connects the float with this registering lever passes through a large oval aperture in the cover plate of the glycerine cylinders, so that it has absolutely free play, and friction is entirely avoided.

When depression in the shaft acts upon the glycerine, the impulse thus set up is immediately transmitted to the recording pen, which makes a corresponding movement upon the chart, the zero line of which is at the top. A continuous record of the depression is obtained. The drum carrying the chart is fitted with a five weeks' clock movement, and records ranging over periods of twenty-four hours or seven days as may be required can be obtained.

A modification of the instrument has been used as a draft gage for boilers and furnaces.

### Government Printing of the Official Gazette.

By reason of recent changes in the publication of the Official Gazette of the Patent Office, the entire work is now being produced by the Government Printing Office. The first number of the Gazette under the new method of publication was issued on July 3 last, and the appearance of the work reflects great credit upon the management of the Printing Office. The public printer has introduced new methods, which not only enhance the appearance of the Gazette, but decrease the annual cost of its publication, as well, to a large amount. The rather antiquated and expensive photolithographic process, by means of which the pages were illustrated, has been eliminated, and the illustrations are now printed direct from zinc etchings incorporated in the type pages and mounted on blocks of type height. Formerly, these were reduced in size and reprinted from dummy cards. The appearance of the Gazette has given rise to general commendation, for the illustrations are far clearer and less difficult of comprehension than formerly. Patent attorneys all over the country are unanimous in declaring the issue of July 3 the best number of the Gazette which has yet appeared and that Commissioner Allen and Public Printer Stillings are to be congratulated on their success in this improvement.

Mr. George I. Rockwood, who is one of the leading authorities in this country on the subject of steam engineering, has been appointed to the professorship of steam engineering in the Worcester Polytechnic Institute. Mr. Rockwood graduated from the Worcester Polytechnic Institute in the class of 1888.

## RECENTLY PATENTED INVENTIONS.

### Electrical Devices.

LOCKING NUT.—L. STEINBERGER, New York, N. Y. This invention relates to locking-nuts, and more particularly to a form of locking-nut admitting of general use and peculiarly applicable in instances where it is desired to lock a nut used in electrical features and especially for the purpose of securing wires in position. It may be applied in any position and practically in any place and upon any work or to any structure where bolts provided with revoluble nuts may be needed.

CIRCUIT-BREAKER.—S. WATERBURY, Schenectady, N. Y. The improvement relates to circuit-breakers and more particularly to those which may be operated both manually and automatically, its principal objects being to secure independence between the two operating mechanisms, so that the closure of the circuit by hand will not interfere with its again automatically opening, and to otherwise improve the apparatus.

### Of Interest to Farmers.

HAY-PRESS.—E. W. KELSEY, Collierville, Tenn. The type referred to here is that of the "rebounding-plunger" press. The purpose of the inventor is to provide an economic form of press operated by horse-power, and to provide a single double-cam-faced operating-lever for the plunger-shaft which has a direct action and which operates with the least possible friction and which also acts upon the plunger-shaft almost immediately upon its return from its pressing-stroke.

### Of General Interest.

CABINET.—FANNIE WOLF, Jersey City, N. J. This cabinet is for use in stores in lieu of shelving, and comprises a plurality of boxes for holding goods, the boxes being arranged in tiers or normally one upon another, the object of the invention being to provide a simple means for raising the several boxes in a tier and supporting the box or boxes above the one from which it is desired to remove articles after said box is lowered from those above it.

GARMENT-RACK.—FANNIE WOLF, Jersey City, N. J. In this case the invention has reference to improvements in racks for displaying cloaks and other garments, the object being the provision of a rack of simple and novel construction on which the garments can be suspended and displayed to customers to the best advantage.

HOSE-SUPPORTER.—A. M. WILSON, Cherokee, Iowa. The aim of the present invention is to provide a supporter and belt for the same arranged to provide an abdominal pad without danger of forming wrinkles and binding the wearer on walking, stooping, or bending sidewise; to obviate the use of undesirable metallic connecting-pieces and to form a convenient means for the attachment of the supporter straps of ordinary construction or such as described in a former patent granted to Mr. Wilson.

MEANS FOR TYING BLOOD-VESSELS.—A. W. FRENTZEN and J. SCHOEMAKER, Leyden, Netherlands. This improvement obviates a former disadvantage by forming the loop separately and thereupon placing on the nippers with which the vein is gripped, the ends of the thread being then pulled to close the loop. The loop slides along the nippers toward the rounded end of the latter, by which the vein is held. Reaching the end the loop slides onto the vein and is then drawn tightly together. To prevent the loop taking unfavorable position on the nippers, the latter are provided with an abutment in form of a finger, spring, or the like which keeps the loop from changing position on the instrument.

### Hardware.

KNIFE.—W. F. WATSON, Tidioute, Pa. The principal object in this instance is to provide means for automatically locking the blade of a knife, especially of that form known as a "jack-knife," in open position. Although especially adapted to jack-knives, it can be used for any kind of a knife having a movable blade. For accomplishing this object means is provided which is inexpensive and which does not add a single piece to the jack-knife of ordinary construction.

VISE.—J. F. MCLEAN, Montreal, Canada. In this case the invention relates to improvements in vises, particularly vises of the "quick-acting" type, in which a pair of jaws are arranged to be freely and quickly closed onto an object, after which they are moved to closer engagement with said object by means of a screw or other mechanical device.

### Household Utilities.

MOP-HEAD.—M. HARTMAN, Upper Sandusky, Ohio. In this instance the invention has reference to improvements in mop-heads made of mop-jam, wicking, or other suitable material and a holder for the same, and the object of the inventor is to produce a simple, cheap, and efficient mop-head and holder which can readily be applied to a handle and can be easily packed and conveniently shipped in large quantities.

NEEDLE-THREADER AND PINCUSHION.—H. G. WILMERLING, New York, N. Y. The purpose of the invention is to provide a construction of needle-threader comprising a tubular body made in telescopic sections for the reception of needles and a head constructed mainly of glass, the glass section being provided with an opening to receive the eye-section of a needle, which latter opening is at right angles to and crosses the needle-opening, whereby such a smooth surface is presented to the thread that it can be quickly and conveniently passed through the eye without any danger of chafing the thread. The base for the body of the threader is in the form of a cushion.

### Machines and Mechanical Devices.

SNOW LOADER AND UNLOADER.—J. O. LINDEN, Prophetstown, Ill. This machine cleans snow from streets or roads and loads the snow into a wagon, from which it may be unloaded at any suitable place, the object being to provide a machine so constructed that the loading and unloading will be practically automatic and in which the working parts may be controlled from the driver's seat.

RAZOR-STROPPING MACHINE. — E. G. KAUFMAN, Yonkers, N. Y. The invention relates to machines in which the strop is manually actuated to rock a shaft connected with the clamp employed for holding a razor in contact with the runs of the strop. The object is to provide a machine more especially designed for stropping ordinary handled razors and arranged to permit convenient insertion and removal of the razor and to insure easy rocking motion of the razor-clamp to bring the cutting edge of the blade into proper contact with the runs of the strop.

PNEUMATIC BRUSH-FILLING MACHINE.—J. MORRISON, JR., Troy, N. Y. The inventor provides improved devices for use in filling brushes and he is enabled to utilize advantageously pneumatic means for showering the bristles upon the dies which are provided with holes for receiving the tufts. He arranges a screen in connection with the die to facilitate the assembling of the tufts. Economy of manufacture results more particularly when the pneumatic showering devices are used.

### Prime Movers and Their Accessories.

HYDRAULIC MOTOR.—J. SCHROEDER, Davenport, Iowa. This invention pertains to improvements in hydraulic motors, the object being the provision of a motor of this character that may be operated with comparatively low water-pressure and having a novel valve-controlling mechanism, and, further to so arrange the parts that there will be no dead-centers.

### Railways and Their Accessories.

HOSE-COUPLING FOR CARS. — D. P. FAHRNEY, H. E. DORAN, and G. A. NEWTON, Springfield, Mo. The purpose of the invention is to produce a coupling which will couple automatically when the cars are brought together and which will have a desirable flexibility, adapting the device for the passing of curves and enabling it to accommodate itself to roughness in the road-bed. The purpose is to provide efficient means for connecting the air-hose and other hose which should run through the train.

RAILWAY-BRAKE.—W. H. WOOD, Lloyd Street, Petersburg, South Australia, Australia. The invention relates to brakes for railway-trucks and other railway-vehicles, and comprises a brake-gear whereby the brakes may be applied to or lifted from the wheels from either side of the vehicle by hand-power. The several parts are so situated and connected that they do not in any way interfere with the side, end, or bottom doors of the vehicle. The hand-levers whereby the brakes are applied have a horizontal movement only and can be operated as a vehicle passes.

RAIL-JOINT.—C. K. FREER, Memphis, Tenn. This improvement pertains to railroad-rails; and its object is to provide a new and improved rail-joint arranged to securely fasten the abutting ends of the railroad-rails together. The joint is comparatively simple and durable in construction, and its parts can be readily assembled to insure a strong joint and support for the meeting ends of the railroad-rails.

### Pertaining to Vehicles.

SPEED-INDICATOR FOR MOTOR-CARS AND OTHER VEHICLES.—R. M. RUCK, 44 Thurloe Square, South, Kensington, London, England. Mr. Ruck's invention has reference to speed-indicators for vehicles (more particularly motor-cars), and it has for one of its main objects to provide in connection with the "excess-speed" indicator, means whereby to enable the speed at which the vehicle is at any moment running to be more readily ascertained than heretofore.

WHIFFLETREE-HOOK. — J. R. HUGHES, Chama, New Mex. Ter. The inventor employs an appliance comprising duplicate reversely-disposed hooks of special embodiment for engaging therewith of a specially-constructed double cockeye having a tug for attachment to or connection with the end of an ordinary harness-trace. The embodiment is such that when this cockeye on the trace-tug is applied to or connected with the said hooks it is practically impossible for the same to become accidentally disconnected therefrom, irrespective of the directions or angles assumed by the tug under ordinary conditions of operation.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

**Inquiry No. 8223.**—Wanted, addresses of manufacturers of all kinds of machine planes and molders for steam engines.

"U. S." Metal Polish. Indianapolis. Samples free.

**Inquiry No. 8224.**—Wanted, a ¼ h. p. gasoline motor for attachment to an invalid's wheel chair, operating to draw the same by friction of the tire.

For bridge erecting engines. J. S. Mundy, Newark, N. J.

**Inquiry No. 8225.**—Wanted, the address of the makers of the Ferguson road carts.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

**Inquiry No. 8226.**—Wanted the manufacturer of the machine for making elbows for stove-pipe and gutters.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

**Inquiry No. 8227.**—Wanted, makers of paper fiber and wood fiber tanks, about 20 feet to 30 feet long by 15½ feet wide.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company. Foot of East 138th Street, New York.

**Inquiry No. 8228.**—Wanted, machinery for making wooden toothpicks.

**Manufacturers of patent articles,** dies, metal stamping, screw machine work, hardware specialties, machinery tools, and wood fiber products. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

**Inquiry No. 8229.**—Wanted, electric welded wire hoops, galvanized gas pipe crosses large enough to receive ⅜-inch pipe with one end cast heavy enough to turn a ball race around the opening to receive the gas pipe and large enough to retain 3-16-inch ball, also steel plate 3 16 inch thick.

Automobile experts are in constant demand at high salaries. Our seven weeks' course is the most thorough and practical, fitting men to drive, handle and repair Day and evening classes. Special course for owners New York School of Automobile Engineers, 146 West 56th Street, New York.

**Inquiry No. 8230.**—Wanted, manufacturers of chest handles, hinges for washing machine, also gas pipe.

**Inquiry No. 8231.**—For manufacturers or dealers in wire for making ornamental novelty.

**Inquiry No. 8232.**—Wanted, manufacturers of charcoal burners, for making charcoal out of refuse wood; also for makers of stump pullers.

**Inquiry No. 8233.**—Wanted, the manufacturer or dealer in the patented device for recording notes of music.

**Inquiry No. 8234.**—For manufacturers of "knuckle-joints" or device used in a similar manner.

**Inquiry No. 8235.**—Wanted, manufacturers of centrifugal gas-cleaning apparatus, of the Edward Theisen type, such as used in Europe.

**Inquiry No. 8236.**—Wanted, dealers in pearl-bearing mussels, also in asbestos.

HINTS TO CORRESPONDENTS.

**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

**Buyers** wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

**Special Written Information** on matters of personal rather than general interest cannot be expected without remuneration.

**Scientific American Supplements** referred to may be had at the office. Price 10 cents each.

**Books** referred to promptly supplied on receipt of price.

**Minerals** sent for examination should be distinctly marked or labeled.

(10061) G. B. W. asks: 1. Does the magnetic field of an inductor dynamo rotate just as if the field coil were fastened to the inductor? A. No; we think the type you name does not. 2. In a slotted armature does the field have to cross an extra wide gap due to the depth of the slot? A. No; the air gap is smaller in a slotted armature. The lines follow the iron in preference to the air, and do not pass out at the bottom of the slots. 3. Does a conductor cut the lines of force or do the lines of force cut the conductor? That is, do the lines of force break on one side of the conductor and reunite on the other when it is swept through the field on the armature of a dynamo? A. Lines of force are not like threads, to be cut. They are not of material substance, and are not cut in any such sense. The wire passes through the field and is resisted in doing so with a force which has a certain value and effect in generating an electric current which is well expressed by the convention of imaginary lines. The lines are as imaginary as the earth's equator. 4. Is there an arc lamp which does not throw shadows because of the up-and-down rods by the side of the carbon? A. Lamps have been made which do not throw shadows. There need be but a small conductor to carry the current to the lower carbon.

(10062) W. B. asks: In a recent issue in Notes and Queries, 5.846 deg. F. is given as the latest figure for the melting point of platinum. Is this misprint for 3.846? A. No; the error in the melting point of platinum arose from using a temperature which was in Fahrenheit degrees as if in Centigrade degrees. The melting point of platinum is given variously from 1775 deg. C. to 2200 deg. C., which would be equivalent to about 3200 deg. to 3992 deg. Fahr.

(10063) S. C. asks: 1. Please let me know the amount of iron wire which is necessary for the core of the armature of the simple motor described on page 500 in "Experimental Science." A. About a pound of wire is required. 2. Would the carbon plates made by the process given on page 705 be all right for the plunge battery on page 401? A. Yes, if well made; but we do not advise an amateur to attempt the manufacture of carbons. He cannot obtain very good results, and they are very cheap in the market. 3. How much bichromate of soda is required for one charging of the same battery? A. To every 6 quarts of water take 3 pounds of sodium bichromate and 1 quart of strong sulphuric acid.

(10064) B. H. G. asks: Please inform me through your Notes and Queries the principle and details of the radiometer? A. The radiometer is a heat instrument. Light has no connection with it. It consists of a glass globe, usually about two inches in diameter, exhausted to a suitable degree. Within is a steel pivot upon which revolves a cross arm carrying four vanes of aluminium, one face of which is blackened by carbon. When heat falls upon the vanes the black faces absorb more than the bright and are hotter. The molecules of air coming in contact with the black faces are heated more than those coming in contact with the bright faces and rebound with more force. The reaction of this rebound causes the vanes to revolve with their black faces in the rear. The globe itself has been made to show a tendency to rotate in the opposite direction to the vanes, this being due to the bombardment of the inner surface of the glass by the stream of molecules which rebound from the vanes. Thus the radiometer is a heat engine, transferring heat from the black side of the vanes to the surface of the glass opposite. A satisfactory explanation of the phenomenon is given in Barker's "Physics," price $3.75 by mail. See also SUPPLEMENTS 13, 37, price ten cents each. 2. Please state also whether energy exists in light, and to what extent. A. Light and heat are now classed together as radiant energy by scientists, and the energy of both is measured by absorbing some material and determining the heating effect it produces. The energy of light as light has not been measured by any mechanical effect which it can produce.

(10065) J. L. M. asks: What is the most practical and least expensive process to produce, as near as possible, an absolute vacuum in a chamber containing about four cubic feet? Will it require a greater capacity of power to empty a large space than it will a smaller one? A. To exhaust so large a space it will be necessary to use a mechanical air pump. It is not possible to produce an absolute vacuum by any means of exhaustion. It will, however, not require any greater power to empty a large reservoir. It will require more time.

(10066) A. L. N. asks: 1. Are there any known substances, preferably metal, which allow some kind of gas to pass through, about the same as light through glass? If so, which? A. We do not know any such metal or substances. The molecules of any gas are much too large to pass between the molecules of a metal. Red-hot cast iron will allow some gases to escape through it, but not with the ease with which light passes through glass. 2. Are there any known substances, preferably metal, which will change temperature, when immersed in some gas? If so, which? A. Powdered antimony or heated copper foil will burn with the evolution of light if dropped into a jar of chlorine gas.

(10067) E. V. V. writes: I have had some little trouble in convincing a man that ice forms on the bottom of a running stream of water, but having seen the same I know I am right. Would you kindly answer same in your valuable paper? A. Anchor ice is often to be seen fastened to the stones on the bottom of a stream, and also to the timbers around a mill. Very frequently mills are stopped by the anchor ice during a very cold snap.

(10068) H. W. J. says: 1. Is concrete made wet stronger than if made dry? A. Concrete should be made wet. It will be a great deal stronger than if made dry. 2. Are concrete walls made of the common form of concrete blocks non-porous? A. Concrete walls of common concrete blocks are porous. 3. Are walls made with oyster shells liable to fail on account of the shells bursting? A. It is somewhat difficult to answer this question, as there are a great many ways in which oyster shells could enter into building material successfully. 4. Is the proportion 1, 3, 5 considered about the proper one for concrete? A. The proper and standard mixture for concrete is 1 part Portland cement, 3 parts clean sharp sand, 5 parts fine crushed stone.

(10069) R. L. M. asks how to make Pharaoh's serpents. A. These are little cones of sulphocyanide of mercury which, when lighted, give forth a long, serpent-like, yellowish brown body. Prepare nitrate of mercury by dissolving mercury dioxide in strong nitric

acid as long as it is taken up. Prepare also sulphocyanide of ammonium by mixing 1 volume sulphide of carbon, 4 strong solution of ammonia, and 4 alcohol. This mixture is to be frequently shaken. In the course of about two hours, the bisulphide will have been dissolved, forming a deep red solution. Boil this until the red color disappears and the solution becomes of a light yellow color. This is to be evaporated at about 80 deg. F., until it crystallizes. Add little by little the sulphocyanide to the mercury solution. The sulphocyanide of mercury will precipitate; the supernatant liquid may be poured off, and the mass made into cones of about ½ inch in height. The powder of the sulphocyanide is very irritating to the air passages, and the vapor from the burning cones should be avoided as much as possible. To ignite them set them on a plate or the like, and light them at the apex of the cone.

(10070) J. H. K. asks how to platinize silver. A. Place some platinum in a small quantity of aqua regia or nitrohydrochloric acid, and keep it in a warm place for a few days, when it will have dissolved. As soon as it has dissolved, evaporate the liquid at a gentle heat until it is as thick as honey, so as to get rid of the excess of the nitric and hydrochloric acids. Add a little water, and it is ready for use. A dozen drops of this solution goes a long way in platinizing silver. The operation is performed in a small glass or beaker, covered with a watch glass to keep in the fumes, and placed in a little sand in a saucer to equalize the heat.

(10071) A. J. C. asks for formulas for printer's rollers. A. To 8 pounds transparent glue add enough water to cover it; let it stand with occasional stirring seven or eight hours. After twenty-four hours, all the water should be absorbed. Heat it in a water bath, as glue is always heated as soon as melted, and when both rise, remove from fire, and add 7 pounds molasses that has been made quite hot. Heat with frequent stirring for half an hour. The molds should be clean and greased. Pour into molds after it has cooled a little, and allow to stand eight or ten hours in winter, longer in summer. Some use far more molasses; three to four times above quantity, and less water. In this case, after soaking one to one and one-half hours, the glue is left on a board overnight, and then melted with addition of no more water, and three or four times its weight of molasses added. Two hours' cooking is recommended in this case.

(10072) B. F. M. asks for information concerning sunstroke. A. Sunstroke is caused by excessive heat, and especially if the weather is muggy. It is more apt to occur on the second, third, or fourth of a series of hot days than on the first. Loss of sleep, worry, excitement, close sleeping rooms, debility, abuse of stimulants, predispose to it. It is more apt to attack those working in the sun, and especially between the hours of eleven o'clock in the morning and four o'clock in the afternoon. On hot days wear thin clothing. Have as cool sleeping rooms as possible. Avoid loss of sleep and all unnecessary fatigue. If working indoors and where there is artificial heat (laundries, etc.), see that the room is well ventilated. If working in the sun, wear a straw light hat (not black, as it absorbs the heat), etc., and put inside of it, on the head, a wet cloth or a large green leaf; frequently lift the hat from the head and see that the cloth is wet. Do not check perspiration; but drink what water you need to keep it up, as perspiration prevents the body from being overheated. Have, whenever possible, an additional shade, as a thin umbrella when walking, a canvas or board cover when working in the sun. If a feeling of fatigue, dizziness, headache, or exhaustion occurs, cease work immediately, lie down in a shady and cool place, apply cold cloths to and pour cold water over head and neck. If any one is overcome by the heat, send immediately for the nearest good physician. While waiting for the physician, give the person cool drinks of water or cold black tea, or cold coffee, if able to swallow. If the skin is hot and dry, sponge with or pour cold water over the body and limbs, and apply to the head pounded ice wrapped in a towel or other cloth. If there is no ice at hand, keep a cold cloth on the head and pour cold water on it, as well as on the body. If the person is pale, very faint, and pulse feeble, let him inhale ammonia for a few seconds, or give him a teaspoonful of aromatic spirits of ammonia in two tablespoonfuls of water with a little sugar.

(10073) J. M. H. wants to know how to harden wood pulp. A. Various substances can be used to harden the pulp, such as glue, starch, and gum arabic, tragacanth, etc. The dry pulp should be mixed with as thin mucilage as is possible to make it stick together when pressed. White clay or kaolin can be also mixed with the pulp to make it like a putty. The molds should be slightly oiled to keep from sticking.

(10074) C. M. A. asks for information concerning sodium silicate. A. Silicate of soda (or soluble glass) is prepared by fusing together carbonate of soda and sand, or by boiling flints in caustic soda under great pressure. It is not soluble in cold water, but dissolves in 5 or 6 times its weight of boiling water. It is employed in the manufacture of soap, in fixing colors, in preserving stones from decay. In admixture with other silicates, silicate of soda occurs in glass; and it (equally with silicate of potassa) imparts the property of viscidity before fusion to such mixtures, which is of great value in the working of glass.

(10075) W. B. K. asks how to temper gun springs. A. To temper gun springs, heat them evenly to low red heat in a charcoal fire, and quench them in water with the cold chill off, keeping them immersed until reduced to the temperature of the water. Place an iron pan containing lard oil and tallow in about equal quantities, over a fire, and place the springs therein, and heat the pan until its contents take fire; then hold the springs in the flames, turning them over and over and dipping them occasionally in the oil to keep them blazing; when the oil adhering to them blazes freely when they are removed from the flames, place them aside to cool off.

(10076) A. S. G. says: Would you please answer by letter or through the columns of your paper, if steam turbine engines have ever been used for automobiles? If so, where can I get a description of them? If not, why could they not be used? A. We have never heard of an instance where an attempt has been made to apply a steam turbine engine to an automobile. The speed at which it is necessary to run the steam turbine of small power would make their successful application to automobile practice extremely difficult. The speed control and power at starting also make the steam turbine less satisfactory than the ordinary steam engine for automobile work. The most serious difficulties with the steam automobiles are with the boilers generating the steam rather than with the engines.

(10077) G. A. D. asks: Would you kindly inform me whether it is possible to build a brick smokestack or chimney 150 feet high, either square or round, which will be strictly plumb from top to bottom? A. In reply to your question as to whether it would be possible to make a brick smokestack or chimney 150 feet high, either square or round, which would be *strictly* plumb, we would say that of course it is impossible to make anything *mathematically* straight or plumb. The difficulty of obtaining proper foundation for a tall chimney, and the possibility of unequal settlement, make it especially difficult to have such a structure come as near to the absolute plumb line as many other structures would. It is customary to give the outer wall of a tall chimney a batter, making the chimney smaller at the top than at the bottom, both for reasons of economy and stability.

(10078) J. N. P. says: 1. Why and how does water put out fire? Why does the water have the same effect whether hot or cold? A. Water puts out a fire by reducing the temperature of a flame below the point of ignition, and is especially efficient for this purpose because of the large amount of heat that is required to turn it into steam. It is almost as effective when hot as when cold, because of the great amount of latent heat in the water. 2. Does the sun shining directly on a cooking stove have any effect upon the cooking? Does it lessen the baking in any way? If when shining on a fire in an open grate, does it reduce the heat? A. The sun shining directly on a stove or fire in an open grate tends to increase the temperature slightly, just as it tends to increase the temperature of any other object. The bright sunlight, however, may make the fire appear less brilliant, and therefore appear to give out less heat. This effect, however, is deceptive.

(10079) J. B. E. says: What will be the approximate cost of installing an electric light plant to furnish 1,000 16-candlepower lights and run one elevator (exclusive of light charges)? The approximate amount of fuel, coal, for 10-hour run? What horse-power steam outfit required? Is direct or alternating current better for private hotel plant? Is gasoline outfit practical for this purpose from standpoints of economy and reliability? What would be the difference in cost of fuel between steam and gasoline with coal say at $2.50 per ton? Is it practical to use exhaust steam in radiators for heating house? Do you consider underground tank with air pressure preferable to elevated gravity pressure tank for private water-works? A. An electric light plant furnishing 1,000 16-candle-power lights and running one elevator will require an engine which will develop from 100 to 120 horsepower and a generator which would generate from 65 to 75 kilowatts. Such a plant will require from three to six tons of coal per ten hours, according to the type of engine and boiler that are installed. Direct current is as efficient and more simple for your purpose than alternating current, and is perhaps more economical and reliable than gasoline. It is perfectly practical to use exhaust steam in the radiators of a heating plant, and if the installation is properly made, this will give satisfactory results and be a great saving in expense. Either an underground pressure tank or gravity pressure can be satisfactorily used for private water works. Nothing is superior to the gravity pressure.

(10080) M. L. T. asks: 1. In the so-called "Highlow" lamp, is the small loop of filament which is used for the small candlepower of a greater resistance than the large one? If so, what is its resistance in comparison with the large one? A. We do not know the resistance of the filaments of the "Highlow" lamp, but the resistance of the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[*See Editorial Section*, SCIENTIFIC AMERICAN, *June 23, 1906, page 512.*]

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side which gives the least light must be much greater than that of the side which gives the brighter light. 2. Is a silk watch chain any protection to a watch from its being magnetized when being carried in the pocket? The first person claims that he wears a silk watch chain while working about a machine (which by the way is a 150-kilowatt rotary converter, 550 volts direct current) so that if it should hit the field casting, his watch would not receive the magnetism by its traversing the chain as it would if it were gold. I claim that the material of the chain would not affect the watch becoming magnetized, but if brought near enough to the machine, the watch would receive the magnetism, even if it were in the pocket. I have always read that magnetism had no insulator; according to this, I believe the silk chain to be no protection from magnetism. Will you please state your opinion of this? A. Your friend and yourself seem to be a little mixed in reference to magnetism, silk watch chains, etc. You are right that magnetism passes through space. It has no insulator, excepting iron. It does not traverse a wire at all. It whirls around a wire in which a current of electricity is flowing, and causes the current to move a magnetic needle, and thus makes voltmeters and ammeters possible. Silk on the other hand is an insulator of electricity, not of magnetism. Electricity cannot get off a wire covered with silk. Gold is a conductor of electricity, and if a gold watch chain touched any uninsulated metal which was carrying a current, a man who might touch the chain in that position would receive a shock. If such a chain should touch the field casting only, nothing could happen, since the field casting is not carrying a current of electricity, but is only magnetized.

## NEW BOOKS, ETC.

TURBINES. By W. H. Stuart Garnett. London: George Bell & Sons, York House, 1906. 8vo.; pp. 283. Price, $2.75.

As the author himself states, the book is intended primarily to give a popular account of the history, construction, and operation of the turbine, and particularly of the various steam turbines which are so properly attracting general public interest at the present time. While the book is excellent from this standpoint, it is naturally not of great value to the student or the expert. Both the water and the steam turbine are treated in this volume. The discussion of each is prefaced with a capital historical sketch of the process of its development. Theory is hardly touched upon, the discussion being almost wholly descriptive. It will undoubtedly prove useful and interesting to that numerous class of people who take an intelligent interest in things mechanical, without any desire of actually becoming masters of any particular branch.

CONTINUOUS CURRENT ARMATURES. By C. Kinzbrunner, A.M.I.E.E. New York: D. Van Nostrand Company, 1906. 12mo.; pp. 80. Price, $1.50.

This book is substantially a translation of the work of Prof. Arnold on the same subject, in which, however, the text was considerably shortened by omitting the discussions of all those windings which are seldom employed for standard machines, though they are practically possible of construction. While Prof. Arnold's method of treating the subject has been closely followed, the descriptions have been restricted to the commonly employed drum windings alone. However, the rules are so given that an intelligent student of the text can undoubtedly design any winding, even though it be not actually included in the discussion. The language of the book is such as to make it of great value for popular student reading, so that notwithstanding that the text is mainly intended for students and designers, the artisan of ordinary intelligence will also be able to comprehend the principles set forth.

POLARISATIONSMIKROSKOPS. Von Dr. Ernst Weinschenk. Freiburg im Breisgau: Herdersche Verlagshandlung, 1906. 8vo.; pp. 147. Price, $1.25.

The second edition of Dr. Weinschenk's excellent book is merely intended to bring the work thoroughly up to date, and to include a discussion of the latest advances in the use of the instrument. Few other changes were necessary. The first edition, issued in 1901, was an excellent book to use in connection with investigations in which the polarization microscope was employed. The art of using this instrument is of comparatively recent growth, but within the last four or five years the development has been exceptionally rapid and extensive, so that this second edition is very timely.

ALTERNATING CURRENT WINDINGS. By C. Kinzbrunner, A.M.I.E.E. New York: D. Van Nostrand Company, 1906. 8vo.; pp. 80. Price, $1.50.

As in "Continuous Current Armatures," only those windings are discussed in this book which are commonly used in practice, and special attention has been devoted to discussing the principles underlying the alternating-current windings in such a manner that even the workman will be able to understand them.

THE WHEAT PROBLEM. By Sir William Crookes, F.R.S. London: Chemical News Office, 1905. 12mo.; pp. 506. Price, $1.40.

The present volume arises out of the comments provoked by the address which the author delivered before the members of the British Association in September, 1898. To put the matter briefly, the author stated that under the present conditions of heedless culture, a scarcity of wheat is within appreciable distance; that wheat-growing land all over the world is becoming exhausted, and that at some future time no available wheat land will be left. The author urged that nature's resources, properly utilized, are ample. He urged that a moderate dressing of chemical manure would pull up the average yield from 12.7 bushels to 20 bushels an acre—thus postponing the day of dearth "to so distant a period that we and our sons and grandsons may legitimately live without undue solicitude for the future." Sir William Crookes's address caused world-wide comment. The book is now in its second edition.

A HISTORY OF ARCHITECTURAL DEVELOPMENT. Vol. I. By F. M. Simpson. London and New York: Longmans, Green & Co., 1905. 8vo.; pp. 260. Price, $5.

This is the first of three volumes which aim to trace the development of architecture through the planning, construction, materials, and principles of design of the buildings described, and to try and indicate the broad lessons which may be learned from them. The half-tones and drawings are excellent, and serve admirably to elucidate the text. The typography is excellent. This book will prove a very welcome addition to the library of all students of architecture, and will also be of value to the professional architect.

THE BOOK OF THE ROTHAMSTED EXPERIMENTS. By A. D. Hall, M. A. Oxon. New York: E. P. Dutton & Co., 1905. 8vo.; pp. 294. Price, $3.50 net.

The Rothamsted agricultural experiments were the basis of modern scientific agriculture, and they are classical. For over sixty years the work of Lawes and Gilbert has been recognized as of the utmost importance from an economical point of view. The great object of the Rothamsted experiments is to obtain knowledge that is true everywhere, and to arrive at principles of general application, leaving the farmer himself, through his more immediate advisers, to adapt and translate them into money. Agricultural science involves some of the most complex and difficult problems the world is ever likely to have to solve. The present volume will prove of value, not only to the scientist, but for any man concerned with the management of land, whether farmer or market gardener, landowner or agent, who wants to learn something of the processes going on in the growing crop and in the soil, as they have been elucidated by the most complete set of field experiments the world has yet seen. The book will prove of great value to students.

HOUSEBOATS AND HOUSEBOATING. Edited by Albert Bradlee Hunt. New York: Forest and Stream Publishing Company, 1905. 4to.; pp. 216. Price, $3.

Houseboating is one of the most delightful ways of living that can be thought of. The present volume goes thoroughly into the subject, illustrating each boat and giving plans of the same. The subject is roughly divided as follows: "Houseboating in America," "Houseboating in England," "The Sailing Houseboat," "Steam Power for Houseboats," "Gasolene Power for Houseboats," "The Stationary Houseboat," "Interior Fitting and Furnishing," and "The Inside Route to Florida." It is a most admirable book.

THE COMPETENT LIFE. By Thomas D. West. Cleveland: Cleveland Printing and Publishing Company, 1905. 16mo.; pp. 268. Price, $1.25.

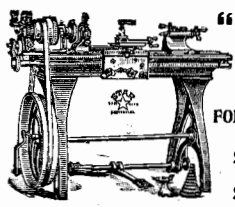
This work is presented to the public as a message on the betterment of labor, and comes from a journeyman to operatives, from an employer to managers, a man to men. The essays are the fruit of much experience and thought concerning the vital question of efficiency, its necessity, and methods of attainment, and is presented with the light and intelligence which two-score years of active service can give. There is much material for thought in the volume.

EMINENT ENGINEERS. By Dwight Goddard. New York: Derry-Collard Company, 1906. 12mo.; pp. 280. Price, $1.50.

This book is composed of brief biographies of American and European engineers. Mr. Goddard has spent a large amount of time in the selection of the engineers to be represented, as well as the matter concerning them. All unnecessary details have been omitted, and only the facts of general interest have been given. Many of the portraits are rare, and were obtained from interesting sources, all of which goes to make the book of great value to everyone who is at all interested in the progress of mechanics.

THE SCHOOL HOUSE: ITS HEATING AND VENTILATION. By Joseph A. Moore. Boston: Published by the author, 1905. 8vo.; pp. 204. Price, $2.

The author has been engaged for the last eighteen years in the inspection of public buildings in Massachusetts, and in supervising the construction of and testing the various methods of heating and ventilation, especially in school

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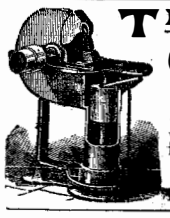

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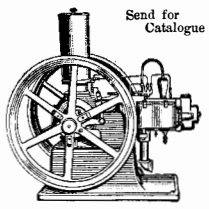

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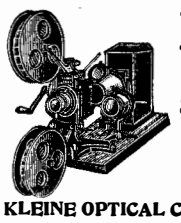

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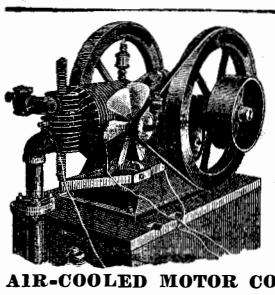

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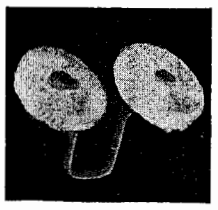

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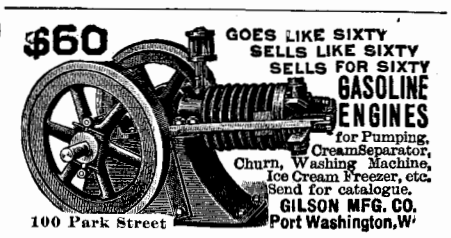


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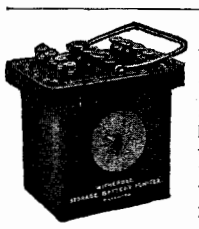

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LECTURES ON THE METHOD OF SCIENCE. Edited by T. B. Strong. Oxford: At the Clarendon Press, 1906. 8vo.; pp. 249. Price, $2.50.

AVOGADRO AND DALTON. THE STANDING IN CHEMISTRY OF THEIR HYPOTHESES. By Andrew N. Meldrum, D.Sc. With a Preface by Francis R. Japp, M.A., LL.D., F.R.S. Edinburgh: James Thin, 1906. 8vo.; pp. 113.

HOUSE HINTS FOR THOSE WHO BUILD, BUY, OR RENT. Philadelphia: House Hints Publishing Company, 1906. 18mo.; pamphlet. Price, 25 cents.

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**AND EACH BEARING THAT DATE**

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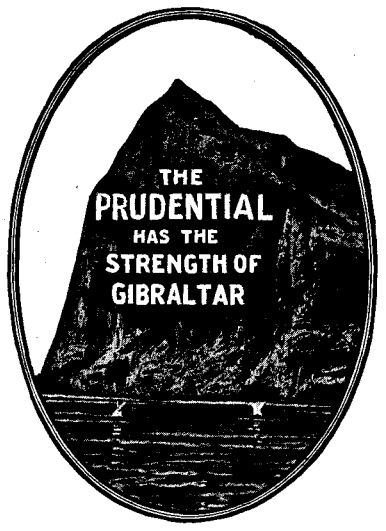


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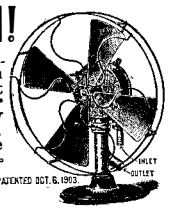


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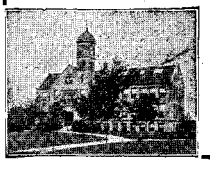

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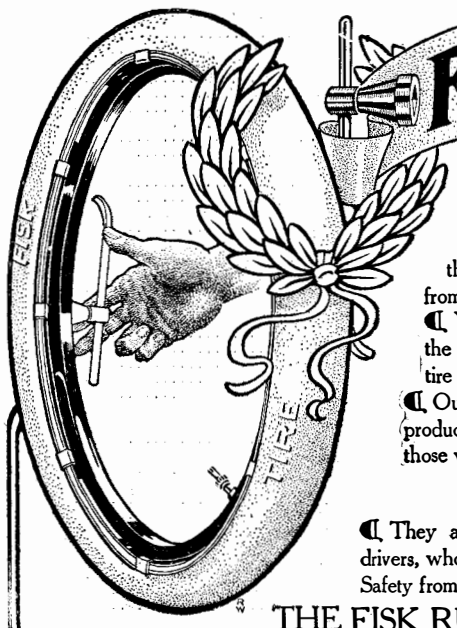


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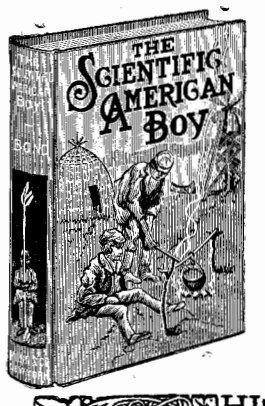


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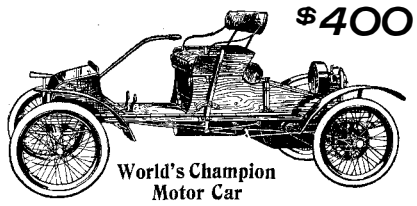

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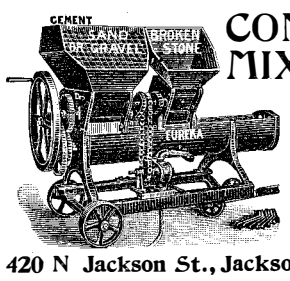


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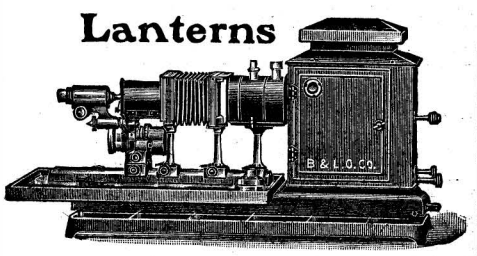

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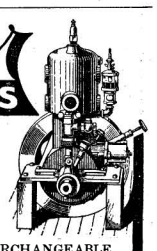

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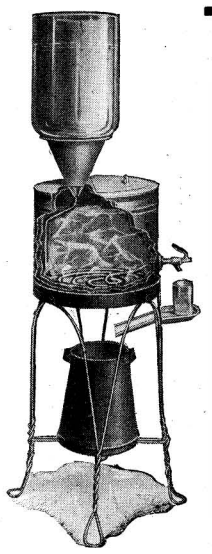

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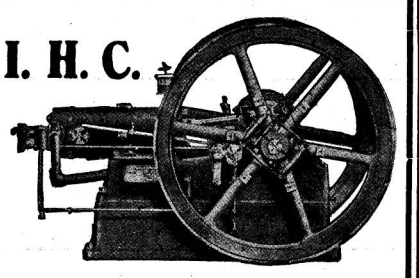

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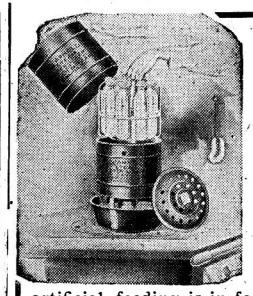

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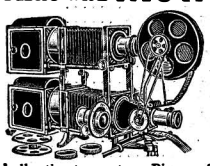

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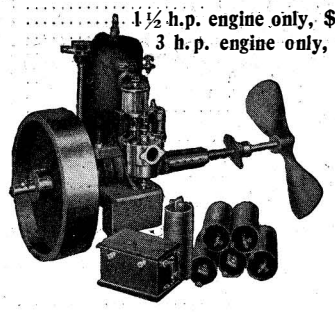

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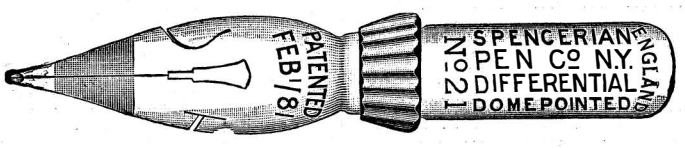


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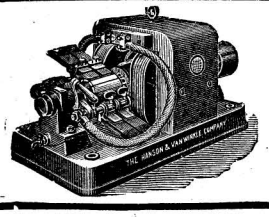

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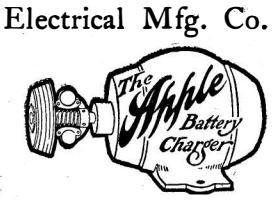


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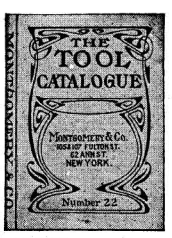


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